NATURE

Vol. 147 SATURDAY, FEBRUARY 1, 1941 No. 3718

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

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Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 147 SATURDAY, FEBRUARY 1, 1941 No. 3718

EDUCATION AS A NATIONAL ASSET

EXCEPT when forced into prominence by questions arising out of evacuation and billeting or public health, even in the limited field of physical training education continues for the most part to be regarded in Great Britain as a secondary matter, and the lamentable repercussions of the War on education policy and content are rarely given the attention they deserve. Even its relation to the vital man-power question through the supply of juvenile labour is rarely regarded from any long-range point of view, and quantity rather than quality would appear to be the main consideration. Certainly it has never received the careful review which is desirable even from the point of view of conserving our comparatively limited resources of man-power and ensuring a supply of men and women of the highest qualities to maintain our efforts and to build a better order after the War.

We have not, indeed, suffered from the illusions the Germans once had about this being a short war; our strategists are planning two, three or even four years ahead. But we are only slowly coming to realize that not the military effort alone, but also every side of our life must be planned for a long war, and indeed for the difficult days that will follow the cessation of hostilities. Particularly is this true of the education of our children. Efforts to safeguard their physical and mental health, and to ensure, both in reception and in evacuation areas, the maintenance of effective teaching, may make all the difference to the efficiency of the war effort and to that other struggle to maintain and extend our liberties and to solve the economic and political difficulties which will confront us in the future.

That the future of democracy rests very much with the teachers of our children, however, is recognized in certain quarters. An admirable manifesto has been issued by the National Union of Teachers, and its plea for every support for the Government's attempt to get all London's children into country districts is strongly reinforced by the figures disclosed in the subsequent statement of Sir Wilson Jameson, chief medical officer of the Ministry of Health, regarding the nation's health, as well as by the report of Mr. Charles Robertson, chairman of the L.C.C. Education Committee, after his visit to evacuated London children. A manifesto issued in December by the Workers' Educational Association urges that the Government must face as a major issue of policy the question whether education is to be allowed to wilt and in some areas to die, and declared that the whole question of civilian morale is at stake.

Without taking an alarmist view, the Workers' Educational Association is disturbed by the threat to the system of compulsory education, and urges that the Board of Education should be given powers to see that every school child is under the care and supervision of teachers. Its recommendations include compulsory school attendance, with alternative home teaching, and stopping the employment of children; State provision for school shelters; the maintenance and strengthening of the medical and social services and extension of communal meals; and the establishment of an advisory committee to review war-time education monthly.

Certain of these recommendations are common with those urged by the National Union of Teachers. One part of the subject has, moreover, been put in its true perspective in a pamphlet by Lady Simon, with a preface by Mr. George Tomlinson, "The School-leaving Age and Day Continuation Schools", published by the Workers'

Educational Association. Our obligations to young people between the ages of fourteen and eighteen cannot be discharged by reviving a measure which would have been a step forward twenty years ago and may still have a place in a more comprehensive policy. The raising of the age of full-time attendance is the next immediate step, to which part-time continued education must be regarded as complementary.

Education cannot be thought of solely in terms of classes and curricula. On a broad view, the instruction which the young receive is less fundamental to their welfare than the kind of life which they lead. "What matters most to children," Lady Simon points out, "is not that they should receive a few hours' additional instruction, but that up to at least fifteen and as soon as possible to sixteen, they should grow up in an environment planned to aid their harmonious development, not in that of wage-earning employment. Continued membership of a good school can secure that ; two half-days a week at continuation schools cannot secure it." Our aim should indeed be to retain all children at school until sixteen, and to establish a system of half-time education to bridge the years from sixteen to eighteen.

In education, as in other fields of national life, we need wide vision and courage if we are to press forward and realize the opportunities before us. We shall not remove the chaos of the schools without a measure of the wide vision and generous spirit of the Spens Report. Something of this is evidently recognized by Mr. Ramsbotham, president of the Board of Education, for in his address to the Incorporated Association of Assistant Masters in Secondary Schools meeting at Oxford he asserted that now is the time to lay plans for great and far-reaching reforms in post-primary education covering the years eleven to eighteen.

Welcome as may be Mr. Ramsbotham's announcement that the Act of 1936 to raise the school-leaving age to fifteen will be enforced as soon as possible after the War, and of his personal belief in the adoption of a minimum leaving age of sixteen, when adequate forms of education to suit varying tastes and capacities of the children have been devised, his statement scarcely carries a conviction of the urgency of the problem or its relation to our immediate war effort. Mr. Ramsbotham, it is true, recognizes the importance of variety and diversity in secondary education, of the need for developing less academic types of post-primary education for many pupils and avoiding fallacious distinctions between so-called liberal and vocational types of education with their obstacles to parity between modern schools, grammar schools and technical high schools.

There is missing in this statement, as in the efforts of the Board of Education in the last twelve months to rebuild our system of compulsory education after its collapse, the vital conception of education as something essential to our national life and effort, the whole quality of which it determines. It is a hard task indeed to hold together the national educational system in face of destruction of and damage to schools, continued migrations of staffs and pupils, and the incalculable demands which may yet be made upon teachers, administrators, premises and equipment by a nation fighting for its life and still far from fully organized by total war.

That is Mr. Ramsbotham's first and immediate task ; and neither his speech nor the circular recently issued by the Board of Education dealing with Air Raid Precautions and other problems arising out of the War, although the latter circular in some measure meets points raised by the National Union of Teachers, displays the vision or resolution which are necessary. To win reform under present conditions demands inspired leadership, dauntless courage, cohesive but flexible organization and a strong common purpose. Even in the reconstruction to follow the War, the demands will be scarcely less searching, and education will be unable to sustain its demands for major reforms unless resolute leadership is supported by far-reaching preparation and careful thought about the problems now.

For that reason the most encouraging part of Mr. Ramsbotham's speech at Oxford may be the statement that he and his advisers are already giving deep and careful thought to the problems of educational reform after the War, so as to have practical and detailed proposals ready when the time comes. Beyond this, however, there is a wide field in which action is already imperative if educationists, and also the nation itself, are to be ready to seize the opportunities when they occur. Already difficulties under which education is being carried on have in themselves enabled its integration more fully into the national life and promoted a fuller general appreciation of its scope and power. Even the limitations and problems imposed by warfare will not be entire loss if those lessons are learnt and the opportunities used.

Mr. Ramsbotham indeed has given us some

glimpses of the possibilities which are immediately before us, for example, if the recommendations of the Spens Committee in regard to medical inspection, school dinners, physical and mental fatigue, and physical exercise and games are explored. More, too, could be done if the Ministry of Health was inspired to urge and guide more co-operation between local authorities, both of contiguous areas and of reception and evacuation areas, and between different departments. Nor should it be too much to hope that attempts to deal with the needs of young workers might be supported by the Ministry of Labour and National Service.

What is indeed certain is that the rebuilding of an ordered educational system out of the chaos of a year and a half of war, and the provision of a tolerable degree of education for those hundreds of thousands of school children whose irrecoverable school years are now being spoiled, can scarcely be achieved by the efforts of the Board of Education alone. The task calls for the highest degree of statesmanship, for a conception of youth as one of the nation's most precious assets, the waste or squandering of which must be prevented at all costs. This conception of youth as a most precious part of our resources of man-power and woman-power, and of education as the potent instrument for shaping it and developing the highest powers of individuals, and for the furtherance of the nation's effort and purposes, should inspire our leaders and guide their policy. This outlook must be shared in some measure by all those who in home, in office, in factory, workshop or camp bear responsibility for training and guiding youth. Upon the sincerity of our belief in education and our fidelity to the service of its ideals the future of democracy in no small measure depends.

Here, as elsewhere, immediate war-time needs and long-term post-war interests are fundamentally the same. Our war-effort largely depends upon the skill and intelligence, courage and moral determination of our citizens, whether in industry, the armed forces or in civil defence. The same qualities contribute to the making of the men and women of wide imagination and broad human sympathies, trained in clear thinking, that the post-war world will require. To implement the recommendations of the Spens Report, to weld cultural, vocational and educational training into a coherent whole, to extend effectively the partnership of educational authorities and voluntary organizations to include industry, to afford youth brought up in the cities opportunities of creative work in the countryside and to develop the enlightenment of the general public and especially of parents, are directions in which advance even in war-time is both possible and desirable. Coupling with this a new approach to the teaching of religion, the youth that enter the armed forces, the civil defence bodies, industry or agriculture, are strengthened continually by those who bring not only the enthusiasm of youth, but also minds alert and receptive, and characters based on real convictions about God and man. Only as we address ourselves seriously to this task of education in the widest and most fundamental sense can we hope that our war-effort will take on that character of a crusade for freedom which Dr. Esme Wingfield Stratton urges so convincingly we must oppose to the fantaticism and State worship of the Nazi.

THE NATURE OF MAN

Man on his Nature

By Sir Charles Sherrington. (The Gifford Lectures, Edinburgh 1937–8.) Pp. ix + 413 + 7 plates. (Cambridge: At the University Press, 1940.) 21*s*. net.

SIR CHARLES SHERRINGTON in his Gifford Lectures takes the task of natural theology to be a survey of the nature of man and his place in the universe from the point of view of the natural sciences, but with the addition of an evaluation of the conclusions in terms of man's moral intuitions: intuitions that lie outside the scope of natural science. The interest of the survey is greatly increased by his comparing his own with one made in the sixteenth century by Jean Fernel, the greatest physician of his day, and mathematician and philosopher besides. Medical science for Fernel was still about where Galen had left it, though Fernel himself was a man of independent judgment and a good observer not prepared to follow blindly after Galen or any other authority. But of course he was still confined to what he could see with the naked eye. Since physics and chemistry were as yet non-existent, not only was there no basis for physiology but the

concept of matter was vague. The principle of life, that which distinguishes the living from the lifeless, was conceived as a kind of fire and might be corporeal or incorporeal or something intermediate. To-day it is possible to speak more definitely. The most fundamental category of the physical world seems to be energy, and the structure of things to be 'granular', as though made up in separate but similar packets; the quantum of action, the electron, the atom, the molecule. At the level of living organisms there is a similar 'granularity' in cell structure and the nervous impulse. There does not appear to be anything incorporeal about living organisms as such. The kind of physical and chemical process they exhibit is complex and peculiar, but still physical and chemical. There is no basic difference in the stuff they are made of, only in certain special arrangements of that stuff.

Fernel considered that life entered the embryo from outside at a definite stage of development. Now it is realized that all living things are part of a continuous chain, such that every organism grows out of other organisms and each cell in their bodies is itself a living organism. The process by which a complex organism develops out of a single cell is an astounding piece of chemistry, but chemistry none the less. The largest and most complex organisms, containing thousands of millions of cells, are nevertheless the most integrated and unified. In the human body the roof of the forebrain is the master organ but it contains no master cell to govern it; it is rather a sort of republic of millions of cells. Fernel had no doubts about the status of mind (though Aristotle had hesitated): it was an incorporeal substance not derived from any sublunar source but from the sphere of the stars. It needed, therefore, a half corporeal mediator, the animal spirits, to enable it to operate on the body.

If life as such has nothing incorporeal about it, can the same be said about mind? Sir Charles Sherrington gives three main reasons for denying that. (1) Mind is unitary and shows no signs of 'granular' structure. With our minds we attend to one thing at a time and one only, but simultaneously our bodies, thanks to instinct and habit, can do several things. (2) While medical science from the study of certain defects of function is compelled to associate these functions with special localized brain processes, for a great deal of psychology brain function is quite irrelevant. Aristotle had many excellent things to say about psychology which are not invalidated by his belief that the heart was the "seat of the mind". Similarly the value of Freud's psychology is entirely independent of anything known or supposed about brain function. However close the connexion between mind and body may be in some respects, it is a connexion between entities belonging to different categories. (3) This is most clearly seen from the fact that it is mind that contemplates the physical world and passes judgments of value on what it contemplates, though unquestionably it has grown out of that very physical world.

After stating the dilemma, that we have to recognize two realms of existence essentially mixed up and yet totally different, the author might have discussed the various theories of the relation of body and mind (Prof. Broad lists seventeen in all). Instead he adopts the wiser course of giving an admirable sketch of what is known of the physiology of nervous system and brain, pointing out how much is relevant and how much irrelevant to the problem, and leaving it as insoluble for present knowledge. Indeed, it is difficult to believe that the theories do more than provide seventeen subterfuges to conceal ignorance.

Natural science, he goes on to say, asks and answers the question 'how' but not the question 'why': it knows nothing of good or bad. Neither apparently does life as such. That kind of life which takes the form of the malaria parasite seems devised with fiendish ingenuity to make the lives of men miserable. Facts such as this make the old argument from design for a beneficent Creator a double-edged one, as Hume pointed out, though fewer facts were known in his day. On the other hand, if man looking at the world finds much in it to condemn, that is a challenge and an opportunity to him to objectify his values, to substitute for blind strife conscious co-operative effort. This is as much, the author concludes, as can be said without exceeding the bounds of strictly natural theology.

If one accepts the author's fundamental premise that the physical world apart from the mind of man is merely what physical science reveals it to be and nothing besides, it seems impossible to avoid his conclusion that there is a radical distinction between the mind and the bodily structure it inhabits, and that nothing except the human mind is of this different kind. From this again it follows that the 'values' that make human life worth living, truth, beauty and charity, are just human inventions. The further conclusion, sometimes drawn, that these 'values' are somehow unreal or illusory, does not, of course, follow logically. Therefore the author's final conclusion seems amply justified, that the fact that man judges certain things to be bad is to be taken as a challenge to fight, not as a signal of defeat. It might, however, be equally justified if one rejected his primary assumption. But if one rejected that, it would imply a complete reversal of the author's view of natural theology. For him any definite

statement about God lies just beyond its boundaries; for the opposed view, the presupposition of the existence of God is the starting-point of natural theology.

If the shade of Lord Gifford has attended at all regularly at the lectures given under his foundation it must sometimes have been irritated and more frequently bored. While listening to Sir Charles Sherrington it should have been well satisfied, as well as deeply impressed with his easy mastery over the knowledge of the twentieth, the sixteenth and indeed several other centuries, and with his skill in making complicated subjects appear simple and lucid. A. D. RITCHIE.

MODERN MICROSCOPY

The Microscope

By R. M. Allen. Pp. viii+286. (London: Chapman and Hall, Ltd., 1940.) 15*s*. net.

IT would be almost impossible to over-estimate the debt we owe to the microscope, yet, as Mr. R. M. Allen points out, the list of relevant books is small. It might further be admitted that, of the vast number of students and research workers who daily make use of the microscope, few, indeed, are as knowledgeable as they might be of the optical principles on which modern instruments are constructed and on which their correct manipulation depends.

The author does not claim to have dealt exhaustively with the many aspects of microtechnique; but, for those working in special fields, guidance is afforded in the considerable bibliography which is appended. The illustrations of instruments are mostly those met with on the American market, in which connexion British manufacturers may well take note of the author's prefatorial comment: "It is to be regretted that English manufacturers, in particular, appear to make no effort to introduce their instruments in the United States, for some of their designs are very appealing to discriminating microscopists."

Having paid tribute to early makers and users of microscopes—the Jansens, Robert Hooke and Anthony van Leeuwenhoek, to mention only a few—and not omitting some reference to writers of much greater antiquity who knew that "a globule of glass filled with water" possessed considerable magnifying powers, the author traces the development of the high-power microscopes that are to be seen in every laboratory to-day. It is a story of more than ordinary interest, combining as it does the cumulative results of empirical test and theoretical concept, for, as Mr. Allen points out, prior to the work of Ernst Abbe (whose design of the two-lens condenser in 1872 affords a useful landmark) objectives had been produced solely by the process of "cut and try, trial and error". To Abbe—by training a physicist and mathematician—the modern method of lens designing is due: "He reasoned that the proper method of approach to the problem was first to calculate on paper the ideal form which the lens components should possess to overcome the various aberrations present in the then known kinds of glass, namely, crown and flint. He argued that if one solved the questions of dimensions, surface curvatures, glass, and all other requirements which the individual lens should meet, instructions could then be issued to the lens makers which, if followed accurately, should produce a finished product possessing the characteristics previously determined. Because Abbe could calculate correctly, the idea worked."

The second chapter, devoted to optical principles, provides information with which every user of the microscope should in some degree be familiar: such topics as the laws relating to image formation, the several types of lenses, the principles of the compound microscope, aberrations in lenses and methods of correcting them, determining magnification in various combinations, limit of magnification, and many other points being simply illustrated and clearly expounded.

Thereafter the author passes on to modern tendencies in design, to the advantages and limitations possessed by models designed for special purposes, the types of instrument suited to the needs of biological, medical, chemical, petrographical and metallurgical research, sections being devoted to the slit ultra-microscope and ultra-violet microscope as well as to the universal microscope, micro-manipulators, etc. The importance of illumination, the methods by which critical illumination can be obtained, the intensity of light required for various purposes, the testing of microscope objectives, all aspects of the care and manipulation of instruments, and the preparation of material for microscopic examination, are discussed in adequate detail.

The author is to be congratulated on his useful and informative text and the publishers on the handsome volume which they have produced.

A FRAMEWORK OF WORLD CO-OPERATION

The War for Peace
By Leonard Woolf. Pp. x + 244. (London : George Routledge and Sons, Ltd., 1940.) 7*s.* 6*d.* net.

THE importance of a clear understanding of the events of the years 1919–1939 is the theme of Prof. E. H. Carr's study of international relations in "The Twenty Years' Crisis" (see NATURE, Aug. 17, p. 209). It is also the theme of Mr. Leonard Woolf's "The War for Peace", and if Mr. Woolf devotes a considerable part of his book to shrewd thrusts at the views advanced by Prof. Carr, both books leave the reader in no doubt as to the value of a close study of this period as a guide to whatever proposals may be advanced for building a new framework of world co-operation.

The events of these two decades prove beyond question the impracticability of leaving until after the War the discussion and elaboration of an organization to preserve peace and promote international co-operation, and the grave danger of attempting to do so in the heat of the passions and resentments aroused by war. The making of peace and the framing of a permanent settlement must be clearly separated. None the less, the broad outlines of a solution to the problem must be available, not rigidly determined, but sufficiently well defined for the task of education and preparation for acceptance to proceed when the fighting has ceased and while passions die down.

Mr. Woolf's acute analysis of war in his opening chapter emphasizes the immediate need for careful consideration of the reasons for the renunciation of war as an instrument of national policy. War and civilization are now mutually contradictory. One or other will be eliminated. The scale of modern totalitarian warfare is so vast and the penalty of unpreparedness is so overwhelming that the probability, even the possibility, of war makes a civilized life impossible. The sacrifices that such preparations demand and the burdens they place on society, involve a permanent black-out of civilized life both in peace and in war.

This point of view is indeed unchallenged. What is in dispute is the means to be used to establish a new order. Mr. Woolf is not unduly optimistic. He believes that if the Nazi regime is overthrown, there is just a chance that there will be a sufficient number of Europeans with a sufficient amount of intelligence and common sense to take the necessary steps to change the international system of power politics and war. He argues that the problem of war and peace in modern Europe has its roots in power and force, national and international, and the place which power and force are given in the relation of States. The problem is one of how to control power internationally, how to substitute a system of law, co-operation, compromise, and consent for power and force in the relations of States, and how to make the transition to a pacific system of this kind at the end of a period of unmitigated violence.

Mr. Woolf devotes a large part of the second chapter of his book to a refutation of the views on power, interests and politics advanced by Prof. Carr and to an examination of the reasons which led to the failure of the League of Nations. He reiterates his view that the real international problem to-day is a choice between the psychology of conflicting interests and the organization of power politics, on one hand, and the psychology of common interests and the organization of international co-operation, on the other. In his third and final chapter he indicates the form that organization should take and the way in which we might reach it.

Mr. Woolf's earlier volume, "International Government", published in 1916, inspired the establishment of what has proved to be the most durable part of the structure of the League of Nations—its system of technical services. In the present volume he favours a reversion to the League system, but in a modified form. The League failed, he holds, because the psychology of co-operation was weak or absent. The machinery of international organization must adapt itself to existing psychology ; if it is too far ahead of the existing nationalist psychology, it will prevent and not encourage its development into international psychology.

The practicability of the League system or of any other proposed system, depends, in Mr. Woolf's view, on three factors : whether its principles and objects, and the form of its organization, conform to the psychology, the beliefs and desires of those who will have to work it ; whether it makes adequate provision for dealing with the interests and power of States and peoples ; and whether the machinery of its organization is really adapted to the functions which it will have to perform. He recognizes the advantages of federation, but considers that an all-European federation is for the present impracticable. Local federations are possible but are incapable by themselves of solving the European problem, though they might supplement the League system.

Mr. Woolf points out that a goal, while unattainable in one rush, may be attainable if you are prepared to work towards it in stages. He visualizes first a world peace system, confederation or commonwealth of nations which would impose on its members less stringent or exacting obligations than did the League. Its members would be bound broadly by the obligations of the Covenant, but in place of the sanctions clause would be bound merely not to aid an aggressor. Within this framework there might be regionalized groups and federations of States more closely united by the obligations of collective security. A European confederation of this type would deal with all international questions which exclusively concerned Europeans and European States, and would establish a system of collective security for Europe.

From such developments we may well find the easiest path to full federation, and Mr. Woolf does not believe that there is anything inherent in the nature of States or of their relations, interests and power which makes such collective security systems impossible. On the contrary, they are inevitable if the whole fabric of inter-State relations and the civilization which has been built upon it in the last two centuries is not to be destroyed. Mr. Woolf may err in not stressing sufficiently the need for fuller investigation into the actual causes of war and on the removal of the social and economic maladjustments all over Europe. It may be held that he is dealing with symptoms rather than causes, but the force of his final warning cannot be gainsaid. If we fail to profit by our experience, if we refuse to create by the democratic methods of co-operation and law the international organization and government which the form of our society demands, federation or confederation may be imposed by force of arms and authoritarian conquest. Mr. Woolf, with his usual lucidity, lays bare this fundamental issue. It is for us to show by creative thought and constructive effort that the free peoples can offer the world a nobler order and finer opportunities than that of domination offered by Nazi Germany.

R. BRIGHTMAN.

HOLLERITH COMPUTING MACHINES

Punched Card Methods in Scientific Computation

By W. J. Eckert. Pp. ix+136. (New York: Thomas J. Watson Astronomical Computing Bureau, Columbia University, 1940.) 2 dollars.

DURING the past twenty years many successful applications of commercial calculating and accounting machines to scientific computing have been made. About fourteen years ago pioneer work in the application of the Hollerith electrical punched-card machines was begun in Great Britain, and has led to the regular use of these machines for many large-scale operations. Their most valuable properties are (1) their ability to use the same number on numerous occasions after one initial recording by means of holes in a card; (2) their large capacity, by virtue of which they can add as many as a hundred figures a second; and (3) the time saved and risk of error avoided by having results recorded, either in print or in the form of further holes in cards.

In spite of its general title, Eckert's book is confined to a description of his admirable personal achievements with Hollerith equipment, including a tabulator model that was standard twelve years ago. He makes no reference to the work of Chapman and Miller on the analysis of periodic phenomena, or to statistical applications, such as that in which Hey and others formed the sums of a million products in two months. The processes described include construction of tables, interpolation, mechanical quadrature, harmonic analysis and synthesis, multiplication of series and solution of differential equations. The applications described are mostly astronomical.

To one familiar with Hollerith machines, the superiority of the British 'rolling total' tabulator over the American machine is very apparent. The former has six counters as against four, greater printing capacity, and the ability to transfer positively or negatively from one counter to another. The American machine has the sole advantage of being able to subtract directly from the card, a feature that the British manufacturers have obstinately refused to include.

Eckert has failed to discuss the economics of the use of punched-card methods, and his schemes appear at times to savour of extravagance. The machines he uses belong to a bureau of which the "purpose . . . is to perform astronomical calculations by means of [Hollerith] machines"; the machines are provided at little or no cost by the vendors. The rentals demanded in Great Britain, although doubtless reasonable in large-scale accounting projects, are unfortunately fatal to many scientific enterprises, and have certainly limited the fields of possible economical application.

L. J. C.

THE CARROT AS FOOD

THE 'King of Vegetables', as it is called in East Anglia, is easily grown and stored. It is universally liked, especially by children. Cooking, by a variety of methods, presents no difficulty, and the preliminary cleaning may be confined to a thorough scrubbing. The roots contain 10–15 per cent of solid matter, much of which is sugar. The green tops are rich in ascorbic acid, the anti-scorbutic vitamin C, and may be used instead of parsley in making white sauce.

Carotene as Provitamin A

The particular value of the carrot as a food, however, arises from its property of accumulating in its root large amounts of the intensely yellow, fat-soluble hydrocarbon carotene, $C_{40}H_{56}$. This pigment, which occurs in several isomeric forms, is found with the xanthophylls, $C_{40}H_{54}(OH)_2$, in all green and in most yellow plant tissues, but is virtually absent from the roots of such common British vegetables as the parsnip, turnip, swede and radish. Potatoes are negligible as a source of carotene.

When foods containing carotene are eaten by animals small quantities are sometimes transferred to the body fat in an unchanged state. Carotene is thus mainly responsible for the yellow colours of butter fat and human blood serum. This transference of unchanged carotenoids, however, shows remarkable, and so far unexplained, variations between species. Carotene is present only in small amounts in egg yolk, the main pigment being xanthophyll. The fats of some animals, including the pig, sheep and rat, are colourless. In all vertebrate animals, however, most of the carotene absorbed from the alimentary tract is converted into vitamin A. This latter substance, exclusively an animal product, is a colourless unsaturated alcohol with a molecular weight of about half that of carotene.

Vitamin A Deficiency

When the amounts of carotene and vitamin A are more than adequate for immediate needs, stores of the vitamin are laid down, mainly in the liver. In the adult human, these reserves usually represent about three months supply at a rate of expenditure equal to the reputed daily requirement. When the diet is low in vitamin A and carotene, however, the reserves are used up. An early effect of deficiency is 'night blindness', which is due to a reduction of the efficiency of the retina in adapting itself to vision in dim light. The recent discovery that the photo-labile pigment 'visual purple' consists essentially of a combination of vitamin A with protein provides a ready explanation of the association of defective dark adaptation with deficiency of the vitamin, although in the complex process of adaptation other factors must also be involved.

More prolonged deficiency of vitamin A, such as occurs frequently in Asiatic countries, leads to the characteristic eye lesion 'xerophthalmia' and also severe skin abnormalities, such as 'toad-skin'. It is important to note, however, that in experimental animals the effects of vitamin A deficiency may be very varied, and that sometimes death may intervene before xerophthalmia or other outward sign of deficiency is developed. The infrequency of visible lesions cannot, therefore, be accepted as an assurance of universal adequacy of the vitamin A intake of the population of Great Britain.

The association of vitamin A with resistance to infection still constitutes a difficult problem. It is quite clear that, in the experimental animal, vitamin A deficiency leads to reduced resistance of the mucous membranes to bacterial invasion. No positive proof of the importance of vitamin A deficiency in the etiology of common infective diseases in humans, however, seems to be available.

Vitamin A Requirement of Man

After reviewing the available evidence, a Technical Commission of the League of Nations, sitting in 1937, assessed the vitamin A requirement of the human adult at about 3,000 I.U. per day (1 I.U. = 0·6 microgram of β-carotene). A more recent careful estimate by German workers places the requirement at 2,500 I.U. of preformed vitamin A, or 5,000 I.U. of carotene in oily solution, the difference being due to the inferior ability of man in using carotene as opposed to the rats employed in calibrating vitamin A against the carotene standard. In practice, of course, the vitamin A requirement will not be obtained exclusively as either preformed vitamin A or carotene, but as a mixture in which the former will be represented mainly by milk, butter, eggs and liver, and the latter by green vegetables, carrots and some yellow fruits such as the apricot.

It is obvious that in time of war there must be a general tendency for a reduction in supplies of the foodstuffs containing preformed vitamin A and of yellow fruits. The requirement must therefore be made up by including increased amounts of green vegetables and carrots. If we assess the daily intake of vitamin A in milk and vitaminized margarine at about 1,000 I.U., then the equivalent of 1,500–2,000 I.U. of preformed vitamin A must be made up by vegetables.

Carotene Content of Carrots

No comprehensive study of the various factors affecting the carotene content of carrots has yet been made. Variety is undoubtedly important; the rather uncommon pale sorts cannot be recommended. In varieties which have the usual reddish-yellow colour, the size of the root has an important bearing on the carotene content. Carrot seedlings have roots which are almost colourless. Tender young roots which are removed as thinnings in spring and prized as a delicacy contain substantial amounts of carotene; but the concentration is often less than half that attained in more mature plants. For ordinary mature carrots, a carotene content of 200 I.U. per gm. may be taken as typical. This value greatly exceeds the 10 I.U. per gm. typical of cabbage.

Efficiency of Absorption of Carotene

If the absorption and utilization of carotene were completely efficient, the part of the daily requirement which has to be provided as carotene could be supplied by as little as 10 gm. of carrots. As mentioned above, however, it has been found in Germany that even when carotene is given in its most readily assimilable form as an oily solution, the efficiency of utilization is only about half that of preformed vitamin A. On this basis about 20 gm. of carrots would be required.

A further complication arises from the difficulty with which carotene is absorbed by the intestines from vegetable tissues. Investigation of this point is not easy for various technical reasons, and it is readily understandable that poor agreement should be found between the results of different workers. As a provisional estimate, however, an absorption of some 20 per cent of carotene when ingested as raw or cooked carrot would seem reasonable. On this basis, about 50 gm. of carrots, or roughly 2 oz., would be needed to make up the daily requirement in the absence of other vegetables.

National Requirement of Carrots

In calculating the national requirement of carrots, allowance must be made for the substantial contributions to the carotene supply made by the various fresh green vegetables which succeed each other in seasonal rotation. The carrot, however, is available in plenty at most times, and can be introduced into the diet in many different ways. Thus it may be used as a 'second' vegetable with roast or boiled joints, may be included in soups and stews, or used in less familiar roles in salads or sandwiches, or for sweetening puddings. It might not be too much to expect the carrot to provide half the total carotene requirement over the whole year, with an allowance of roughly 1 oz. per head of the population per day.

At this level the place occupied by the carrot in the menu should be frequent, but not unduly prominent. In families with a particular liking for this vegetable, much larger amounts might be used with advantage. An allowance of 1 oz. per head daily is equivalent to about 400,000 tons annually for the whole population, without allowing for wastages in distribution and cooking.

Storage and the Disposal of Surplus Supplies

In ordinary farming practice carrots may be readily stored in clamps. No change in carotene content is to be expected, provided the roots remain in sound condition. Canning also has no injurious effect, the carotene remaining stable even when the cans are kept for prolonged periods in tropical countries. In selecting carrots for canning, young spring carrots should not be chosen, even though their greater monetary value might appear better to justify the cost of canning. As stated above, the carotene content of mature carrots is much higher, while the differences in flavour of young and mature carrots after canning are slight.

As a further possibility, the drying of carrots might repay investigation. When dried under suitable conditions carrots retain much, if not all, of their original carotene, although the precise conditions required for stability remain to be defined. Dried carrots might be cooked in the usual way after soaking in water, or alternatively might be ground down to a fine meal. Dried carrot meal has a pleasant sweet taste, and might be valuable as a war-time constituent of cakes or biscuits. With the present scarcity of oranges the inclusion of a moderate proportion of carrot in marmalade has been suggested.

Finally, one important point must not be forgotten. As mentioned above, considerable stores of vitamin A can be accumulated in the liver. An excellent way to dispose of any hypothetical surplus of carrots therefore would be to stimulate immediate consumption. The increased storage of vitamin A in the livers of the population would represent a real national asset. Not only would we be in a better position to withstand any shortage of vitamin A which might occur during the following months, but we would also probably benefit immediately by improved dark adaptation, with a corresponding reduction in road and other accidents occurring after 'black-out'.

FLORA AND FAUNA OF THE INNER AND OUTER HEBRIDES

By Prof. J. W. Heslop Harrison, F.R.S.

In NATURE of June 17, 1939, p. 1004, was published an account of King's College (University of Durham) Biological Expeditions to the Inner and Outer Hebrides, bringing the records of our results up to the end of 1938. Since then the work has proceeded steadily, although not to completion; nevertheless, in view of present circumstances, it seems best to supply a similar summary of the fruits of our 1939 and 1940 investigations.

Despite obvious difficulties, we have spent considerable periods during those years on the Islands. Thus, in the late spring of 1939 we visited Mull, Coll and Tiree, continuing our work in summer by exploring Lewis, Great Bernera, Little Bernera, Harris, Berneray, Pabbay (Sound of Harris), North Uist, South Uist, Fuday, Fiaray, Barra, Muldoanich, Vatersay, Flodday, Sandray and Pabbay (Barra Isles). Similarly, in the early summer of 1940, we concentrated our efforts on Tiree, Coll and Gunna, returning later to Coll to examine more closely certain aspects of its flora, and then ending the season by exploring the Isles of Benbecula, South Uist and Colonsay.

As usual, both the flora and fauna of the islands were studied, but the plants proved the most productive of novelties. In particular, our researches have added greatly to our knowledge of the distribution of several important elements in the British flora: (1) those of boreal and alpine proclivities, (2) those of southern and south-western origin, and (3) those of American affinities.

Before we commenced our work, the majority of species belonging to the first-named section was supposed, of necessity, to be restricted to the mountains of Lewis and Harris. Now it has been shown that a new 'focus' for such plants exists in the Beinn Mhor, Feaveallach, Hecla area of South Uist. Upon this more or less unglaciated mountain massif we have observed up to date, *Thalictrum alpinum*, *Cochlearia alpina*, *Saxifraga oppositifolia*, *S. stellaris*, *Oxyria digyna*, *Epilobium alsinifolium*, *Saussurea alpina*, *Salix herbacea*, *Alopecurus alpina*, *Deschampsia alpina*, *Poa alpina*, *Carex vaginata*, *C. rupestris*, *C. rariflora* and *C. rigida*. In addition, we have detected there a second and very peculiar species of Epilobium with fleshy, characteristic leaves. This was not in flower when collected: nor have specimens brought home alive flowered since. Almost certainly the plant is the arctic *Epilobium Hornemanni*.

In extending the list of boreal and alpine forms, other Outer Islands have added their quota as, for example, *Silene acaulis* (Berneray and Mingulay), *Cerastium arcticum* (at a low elevation on Rueval, Benbecula), *Oxyria digyna* (Mingulay and Pabbay) *Ajuga pyramidalis* (Barra and Muldoanich), and *Salix herbacea* (Barra and North Uist). Of importance, too, is the fact that we have also collected *Silene acaulis* and *Polygonum viviparum* at sea-level at Uig in the west of Lewis and on Little Bernera off the same coast.

Furthermore, in spite of the low altitude of Coll, its rocky outcrops and sand dunes have been shown to support strong colonies of *Saxifraga hypnoides*, *Ajuga pyramidalis* and *Carex rigida*.

Of southern and south-western plants, *Juncus capitatus* has been taken on Barra, whilst not far away the muddy shores of Loch St. Clair have yielded *Illecebrum verticillatum* (a plant already recorded for Eriskay by Goodrich-Freer) to several members of our party. On Fuday we had the pleasure of seeing a single plant of *Cicendia pusilla*, whilst South Uist likewise produced the same plant, with *Herniaria glabra* var. *ciliata* in addition. In this connexion, too, we should like to emphasize the confirmation of the occurrence of *Epilobium tetragonum* in the Outer Isles, with the significant addition of *E. Lamyi* on Fuday and South Uist.

For its headquarters in the Hebrides, the

American element possesses the Isle of Coll. There we had the privilege of marvelling at the abundance of *Eriocaulon septangulare* in a dozen lochs, in the Loch a Mhill Aird, Loch Ronard and Loch na Cloiche area. More widely spread in the island was the Irish ladies' tresses orchid (*Spiranthes Romanzoffiana* (*stricta*) which flourishes in two distinct forms on the grassy moorlands lying between Loch Cliad in the centre, and Sorisdale and Bousd in the extreme north-east. The third American plant favouring Coll, *Sisyrinchium angustifolium*, can only be found, so far as we are aware, on a very limited habitat on a slope leading from the south-east margin of Loch Cliad. The distribution of the fourth member of the same group, *Naias flexilis*, is different; it has been dredged from various lochs between Howmore and Stoneybridge on South Uist, and from Loch Fada on Colonsay, the forms from the two islands differing somewhat. In all probability there should be added a fifth member to this select band in the form of *Epilobium adenocaulon* which has turned up, significantly enough, on Coll and South Uist. However, recognizing its presence as a colonist in the south of England, we do not, for the moment, stress the fact.

From the above remarks it will be clear that the deductions put forward in our previous report continue to receive weighty support. It seems certain that, as we have urged previously, the Alpine and northern forms as well as more tender southern species, possibly of diverse origins, have survived the Glacial Period in a much more extensive 'Long Island' than exists to-day. Moreover, other pictures are forming. As our researches have progressed we have been increasingly impressed by the very marked relationships existing between the flora of Coll, Tiree and Gunna on one hand and that of the Outer Isles, south of the mountain group of South Uist, on the other. This similarity stands in obvious contrast with the many differences observed between the floras of the northern and southern halves of the Outer Group of islands. Without doubt, these are definite indications that, when the flora of the Outer Hebrides was being stabilized, conditions within that group were far from being uniform throughout. This position, too, receives confirmation from the distribution of such Lepidoptera as *Argynnis aglaia*, *Pieris napi*, *Eumenis semele*, *Eubolia mensuraria* and of other insect species. Utilizing the whole of the available evidence, we are driven to the conclusion that the Coll, Gunna and Tiree of that period had much freer communi-

cations with the southern Outer Isles than with the northern series.

Further, the concentration of the American element in Coll recalls a similar grouping in Ireland, thereby indicating the possibility of a land connexion between Coll and Ireland long after the Outer Islands had parted company with both. This view is backed up by the fact that quite recently we have discovered the Irish race of the greasy fritillary butterfly (*Euphydryas aurinia* var. *praeclara*) in Coll and Tiree and the Irish burnet (*Zygæna purpuralis*) on Gunna.

On the other hand, it will be remembered that in our earlier contribution we used the endemic *Rosa Sherardi* var. *glabrata* as a pointer in respect to what islands should be regarded of mainland proclivities, or to have been detached recently therefrom. One of our workers, Dr. W. A. Clark, collected this rose on Mull in 1939, so that, accepting our test, Mull lines up with the mainland. If appeal be made to the insects, the same result appears, for the Hebridean bee, *Bombus smithianus*, dominant in the Coll group, fails in Mull, to be replaced, as on Skye, by its ally *Bombus muscorum* var. *pallidus*, a form almost certainly derived from mainland sources.

In conclusion, it is not proposed here to repeat the argument employed in the 1939 paper to support our views concerning the Pleistocene and early Holocene history and geography of the Hebrides, but we do wish to urge that our work supplies weighty reasons for a rearrangement of the accepted limits of the Watsonian vice-counties into which, for biological purposes, the British Isles are divided. As we have accumulated our mass of facts, we have steadily been forced to the view that the acceptance of the Isles of Skye, Raasay, South Rona, Scalpay, Pabbay, Longay, Soay, Rhum, Canna, Eigg, Muck and Hyskeir as forming vice-county 104 cannot be defended, for it conceals the very serious discrepancies between the flora and fauna of the first seven and those of the last five. Similarly, we believe that the linking of Mull and its adjacent islets with Coll, Gunna and Tiree as vice-county 103 is likewise biogeographically unsound. Attaching due weight to the unmistakable connexion between the floras and faunas of Coll, Tiree, Gunna, Rhum, Eigg, Canna, Muck and Hyskeir and those of the Outer Isles, we suggest that a proposal to label the first three islands as vice-county 110A and the remainder as vice-county 110B should be deemed worthy of very careful and favourable consideration.

Fig. 1.
PIPE-WORT (*Eriocaulon septangulare*), LOCH A MHILL AIRD, ISLE OF COLL.

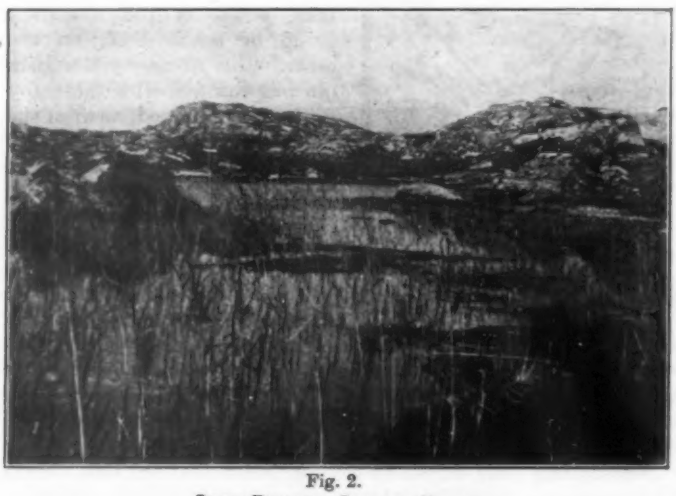

Fig. 2.
LOCH RONARD, ISLE OF COLL.

THE VISION OF ANCIENT LIFE*

By Prof. Rhys Carpenter,
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IT has been the destiny of classic Greek civilization to serve as a mirror of perfection into which later ages might peer and see the good, the beautiful, the true. Within that magic glass the ordinary world has been transmuted to a stately calm, a pageant of august forms—beautiful boys, god-like youths, and serene elders, moving among white temples beneath sunlit skies. Read Goethe's "Iphigenie", consult the painters and sculptors of the late eighteenth and early nineteenth centuries, listen to John Addington Symonds and Walter Pater—not one has cherished any serious doubts of the perfection of the classical ideal. Theirs has indeed been an untroubled vision of ancient life.

But it is unnecessary to tell an audience from the disillusioned year 1940 that such a vision must be false, that this classic world has been conjured up through glasses of enchantment and that, had those glasses possessed any of the accuracy of the optician's or the laboratory worker's lenses, the ancient world would have lost its iridescence, the crystal must have revealed its flaws. It has been the modern archæologist's sad privilege to provide glasses of disenchantment and to stare through them steadily at the beauty of Greece. Long before his time, however, the political historian had discovered that all was not well with Hellenic polity, that an Ægean world of unintegrated, narrowly self-conscious, democratic City-States had consumed itself in jealousy, intrigue and hatred, and had finally succumbed to every military dictator who chose to move against it. Still, this was only an imperfection of a special and restricted kind. Even while they deplored the feral self-destruction which lurked within Greek civilization, these same historians repeated the chant of the serenity of Greek art, the calm superiority of Greek letters, the instinctive beauty of the Greek way of living. It needed the archæologist to discover that there was no single material aspect of the classic civilization which could endure a really close scrutiny and still maintain its calm poise of assumed impeccability.

A measuring-stick and a scrupulously attentive eye can work strange havoc with the perfection of a Greek temple. Identical parts refuse to reveal identical dimensions: some are over size, some under, others are miscut and patched; errors of computation vie with errors of execution; outright miscalculation betrays itself under a guise of last-minute improvization. The most perfect of ancient buildings, the Parthenon, sets us some surprising problems. In their general trend, most of its irregularities are deliberate. The curving steps, the leaning superstructure, the gradual increase or decrease in size of identical members as we move toward or away from the corners of the building—these are not errors or accidents, but are wisely founded in optical æsthetics, in the laws of artistic vision. But look and measure a little closer still: the curve of the steps is no longer a true curve at all, but a ragged broken line; the leaning columns and entablatures sway and stagger; the changing dimensions move fitfully and out of step. Are these still more subtle, but equally deliberate, refinements? Is this inaccuracy merely a coldly calculated blurring of the mathematically too perfect calculation? Or are they all mere human frailty, marking the natural limits of artistry and revealing the unselfconscious slipping of hand or eye or brain? There are champions of both interpretations. But the defenders of Greek perfection *à l'outrance*, who refuse to allow that a modern scientific instrument can detect an aberration which the ancient artist had not seen and willed, these are gradually being removed from the ranks of the men of science, to take refuge among the mystics and archæological astrologers.

Again, the most casual spectator can perceive the marvellous technical achievement inherent in Attic pottery, the baked, glazed and painted clay which was shaped to cups, pitchers, bowls, and jars with such consummate mastery of curving outlines and balanced harmony of form. But again the more scrupulously attentive eye, resigned to the use of calipers and foot-rules, will fall foul of the same predicament as in the temples. These tiny deviations from exactness, these shifts and changes from an obvious potter's norm, do these betoken the inmost subtleties of the Greek creative brain, or do they but mark the normal limit of human attentiveness and ambition? Again there have been champions of both interpretations. The ingenious exponents of dynamic symmetry have stripped the potter's wheel and kiln—even his clay and water and air—of their casual variability; but in order to rescue their ideal of

*Substance of a paper read at the Bicentennial Conference, University of Pennsylvania, on September 16.

Greek infallibility, they have had to take refuge in a special geometry which is not so much abstruse as meaningless. These are quarrels of our profession dating from our own times; but even if some of their differences have not been finally composed to the satisfaction of all contestants, the general trend of the results is clear. Beneath the merciless scrutiny of modern scientific instruments of precision, the utter perfectness of Greek artistry has proved illusory.

In statuary, where the dogma of Greek ideal perfection has been perhaps most obstinately enshrined, the outcome is the same. The Hermes of Praxiteles was so miscut by its unknown maker that a considerable portion of the back had to be rehewn after the statue was all but finished. In the pediments of the Parthenon one of the figures was so tall that its head struck the overhanging marble cornice and a hollow bed had to be sunk in the pediment floor before the piece could be fitted into its proper position. Another pair of statues jostled each other for room to such an extent that at the last moment a workman had to chip away from the finished sculpture an obstructing projection. High in the Arcadian mountains, when the twenty-three slabs of a carved frieze to adorn the interior of Apollo's newly built sanctuary near Phigaleia reached their destination, the frieze proved to be so much longer than its intended space that there had to be recourse to extensive mutilation, applied even to shoulders, legs and arms of the struggling figures, before the sculpture could be set; and even then—at least in my judgment of this most intricate problem—the slabs were not aligned in the sequence which the artist had originally designed for them.

If it be objected that all such errors apply only to rather external and mechanical miscalculations and misfortunes, and that, considered as works of art, the individual statues none the less display the ideality and perfection of the great Greek tradition, I can only ask for more careful inspection of the course of Greek sculpture as it is nowadays understood. Here there is no static ideality of perfection in the accepted sense, for this involves the immutability of the abstract form, and that which is perfect (as Plato taught) is not subject to change; whereas, in Greek sculpture everything changes and nothing abides, whether in technical procedure or in artistic taste, in ambitions or abilities. If Polycleitus is Greek perfection, then Praxiteles and Lysippus belong to the decadence. The Victory of Samothrace, the Aphrodite of Melos, the Belvedere Torso make the attainments of Pheidias and Calamis and Myron appear undeveloped, struggling, immature. "No one bathes twice in the same river," said Herakleitos; yet the river abides. But the aphorism will not fit the stream of artistic effort and production, for here even the stream itself is constantly changing its behaviour and appearance. To select a single phase or period, to insist that by the classical perfection we mean (let us say) only the later fifth century before Christ, is arbitrary, disputable, too manifestly partial. The flowering of the various arts does not synchronize to make a common period of perfection. Pindar and Aeschylus were not contemporaries of Polycleitus and Skopas, nor were these in turn still alive when painting reached its prime.

It is not without importance for our argument to observe that the aftercomers, the *epigonic*, looking back on the Greek splendour and admiring it as the golden age of civilization, have not been unanimous on the phase or period of Greek culture which should most merit their approbation. Thus, to confine the topic to Greek sculpture, the taste of Augustan Rome singled out the fifth century B.C. and the severe athletic tradition of Polycleitus and his immediate predecessors as displaying the ideal of classic perfection, so antithetic to the advanced realism of the contemporary tradition. A little later, in the time of Nero, preference seems to have veered towards the fourth century and to have sought in Skopas and Praxiteles the truest norm of sculptural beauty.

Still later, in the time of Hadrian, there seems to have developed a very general liking for the archaic of the late sixth century and the formal art of the late fifth century B.C.; but in each case with a marked leaning toward its florid forms and the affected elegances in which both these periods culminated. In more modern times, Lessing saw the acme of sculptural achievement in the Laocoon, a work of the very close of the Greek creative period. Winckelmann and Goethe found the purest manifestation of the Greek spirit in Roman copies of Greek divinities from the fifth century B.C. The late nineteenth century despised the Apollo Belvedere, previously so greatly admired, and exaggeratedly commended the simply posed nude youths and elaborately draped maidens of the last of the sixth century B.C. To-day the taste of students and connoisseurs has passed behind the archaic to the primitive, and thought to find in the geometric phase of earliest Greek art the essential Hellenic striving for clarity and essential form, the Greek genius for narrative simplification in its starkest and hence most powerful aspect. So great a variety of taste can only suggest that Greek sculpture was not the immutably serene achievement of the European neo-classic tradition, but a shifting struggle against recalcitrant materials, a driving forward toward

new objectives, with all the consequent diversions of convention and revolt which mark art for a living process persisting only through ceaseless unrest and strife.

Under the scrutiny of archæology, the classic world thus disintegrates. It relinquishes its immutability, its aloofness, its calm, in short its classic quality. Just as the honest historian must find beneath the great men and great deeds of the past the same ill-willed unstable human nature, the same greed and cruelty and stupidity which stalk abroad through all our own lands and times, so the archæologist, peering close, penetrates the shimmering iridescent veil of the classic illusion in ancient life and art. Instead of a radiant and superhuman cloud-built quiet he finds a noisy flux and quarrelling, the failure and falsity which beset all human activity. Any true vision of ancient life must comprise innumerable glimpses of violent action and pitiless mutability, striving and mistake, disagreement, ill-luck, and ever-recurrent determination to succeed. The classical view of the classical world errs through just this absence of error and failure and conflict. Its very assumption of ideality and perfection marks it out as unliving and therefore as unreal.

We need not labour the point that the political, social, and moral background of the most ideally aloof of all artistic periods, the middle decade of the fifth century B.C., was one of bloodshed and disillusionment. Yet I cannot adequately make my point without some more specific reference to these divinely civilized Greeks as they saw and reported themselves for the benefit of posterity. The island of Melos hoped that it could remain neutral during the war between the two leading powers of the Greek world. But the Athenians came to it with the disheartening realistic observation that "as things are in this world of ours, Right exists only among powers of equal strength, whereas the strong do whatever they are able and the weak suffer what they must". Replied the Melians, "But all the other neutrals, when they see our plight, will side against you for fear that some day or other you will overrun them also". Nevertheless, and for no better pretext than that it was not convenient for them to have a neutral State in their immediate strategic neighbourhood, the Athenians attacked Melos; and when the inhabitants finally surrendered and threw themselves on their mercy, they put to death all the grown men, sold the women and children for slaves, and settled their own countrymen in the depopulated island. This was in the year 416 B.C., while Sophocles was still composing his ethically lofty dramas for the Attic stage, while Socrates was teaching moral philosophy to the youth of Athens, and the pupils of Pheidias had just finished carving the exquisite reliefs of the Nik Temple parapet.

Those were the times of which Thucydides wrote despairingly when he saw how a great war could destroy all the traditional tenets of civilized behaviour. As revolution spread from State to State, he noted the ever-increasing treachery of human relations, the atrocity of their mutual reprisals. Under stress of such forces, "words lost their normal meanings," he explained; "honour in action was despised and finally relinquished; society became divided into factions wherein no man any longer trusted his fellows . . . there was neither promise kept nor oath respected . . . in men's hopelessness for any enduring order of things, mere desire of self-preservation replaced all confidence and sense of security. . . . Human nature, instinctively rebellious against law and order"—(I am still quoting Thucydides)—"now shaking itself free, revealed itself ungovernable in its passions, without respect for justice, the foe of all authority. . . . The entire Hellenic world was drawn into the struggle . . . and the sufferings which resulted were as numerous as they were terrible, being even such as have occurred before and will occur again, so long as human nature remains what it is".

"So long as human nature remains what it is." This single phrase from Thucydides should be enough to shatter into a thousand splinters the silver mirror, the sunlit crystal, of the classical illusion.

Whence then came this persistent modern misrepresentation of the Greek genius? What inherent quality has thus caused Greek (and in so far as it is under Hellenic tutelage has included Latin) to serve as the outstanding example of the classic spirit? So far as the term itself goes, the word 'classic' means only highest grade. But this very usage implies a certain standard or norm or scale of perfection, which sets the classic thing apart, *hors concours*, among the jury rather than among the petitioners and general public, aloof, unattainable, Olympian. If only we could be content to claim that Greek and Roman literature rank high among the best of the world's literatures, that Greek sculpture may be merely its finest sculpture, Greek architecture deserves place with its noblest architecture, there would be little damage done to ourselves or to the Greek tradition; but we have made a special caste of these Hellenes and turned them into untouchables, at the top rather than at the bottom of our social order, isolating them from all other literature and art, and by this very segregation conferring upon them a bloodless and lifeless unreality. For in the final analysis the flawless is inhuman, the impeccable is hateful, and classical perfection is a bore.

OBITUARIES

Prof. Raymond Pearl

PROF. RAYMOND PEARL, whose sudden death from angina pectoris has been announced, was born at Farmington, New Hampshire, in 1879. He graduated A.B. from Dartmouth College in 1899, took the degree of Ph.D. in the University of Michigan in 1902 and afterwards worked at Leipzig and under Prof. Karl Pearson at University College, London. After holding some junior posts in the Universities of Michigan and Pennsylvania, Pearl was appointed head of the Biological Department of Maine Agricultural Station, where he remained until 1918, when he was chosen to be the first professor of biometry and vital statistics in the newly created School of Hygiene in Johns Hopkins University.

Although few heads of departments have been more inspiring teachers and Pearl's enthusiasm was invaluable in the infancy of the School, he did not care for routine teaching and in 1925 took a research professorship, being succeeded in the chair of biometry by his friend and collaborator L. J. Reed; from 1930 to his death he was professor of biology in the School of Hygiene and had in his institute an enthusiastic group of research students.

Pearl was an indefatigable worker; he published thirteen books and a large number of papers. His fundamental training and interests were biological and his outlook had some resemblance to that of Weldon. Although most of the publications of his later years would probably be indexed as statistical, he was a biometrician rather than a statistician, not greatly interested or highly skilled in the modern mathematical developments of statistical theory. His contributions to statistical technique, although far from negligible, were not of first-rate importance; his *forte* was the planning of experiments and using a sound biometric method in the analysis of results.

His earlier work on poultry breeding showed these characteristics, and his well-known experiments with Drosophila probably mark his highest level of purely scientific work. Weldon had substituted groups for individual specimens in biological study; Pearl carried this further. He acquired consummate skill in varying the environmental conditions of genetically pure strains of Drosophila, maintaining numerically respectable 'populations' under the desired conditions. He was thus able to record the vital-statistical histories of communities of flies with a precision which a medical officer of health might envy.

Pearl was led to generalizations respecting the influence of environment on mortality which were of much interest—for example, that, from the point of view of mortality, there was an optimum density of population—and should stimulate much more experimental work.

Pearl, like Alexander Pope, believed that the proper study of mankind was man, and in his later years, although he still actively promoted laboratory experiments in his institute, devoted much of his own energies to the study of demography, to the factors regulating the growth and decline of nations. He was a clear and forceful writer so that what he wrote was always interesting; but, to those old enough to remember the thrill of early biometry, his demographic researches have not the charm of his experimental work.

Eager and original-minded men sometimes make mistakes. Great enthusiasm and stern self-criticism are not common bed-fellows. Pearl was sometimes involved in controversies and not always on the winning side. He would scarcely have been so lovable a man and had so many friends on both sides of the Atlantic had he been the ideal man of science of fiction. His general influence on the development of biometry has been great and salutary. His death is a serious loss to science.

MAJOR GREENWOOD.

Prof. J. H. Smith

THE death took place on December 24 of Prof. J. H. Smith, formerly head of the Mechanical Engineering Department at the College of Technology, Belfast. Prof. Smith studied at the Royal College of Science, London, and afterwards at Victoria University, Manchester, where he carried out important researches on the fatigue of metals under the late Prof. Osborne Reynolds. His first appointment was to Sunderland Technical College, where he was head of the Department of Civil and Mechanical Engineering for a period of two years.

Going to Belfast in 1905 as head of the Mechanical Engineering Department in the College of Technology, he found the present building just completed, and his first task entailed the equipment of the engineering laboratories and workshops. His careful planning and inventive genius resulted in the production of laboratories, etc., which were opened by the late Prof. Perry in the year 1911, and described by him as the finest he had ever seen. A description of the laboratories appeared in *Engineering* at the end of 1911.

Technical education at this period was in its infancy in Ireland, and Smith took a leading part in organizing engineering courses not only for the Belfast College but also for those in the provinces.

Smith's fertile brain was continually engaged on research problems, and the results of his many investigations on fatigue of metals, which he continued in Belfast, appear in the publications of the Iron and Steel Institute. The ability which he possessed in applying theory to practice was recognized by many engineering firms, and he was continually engaged in the investigation of practical engineering problems. Chief amongst these was his investigation of the vibration in double reduction geared turbine-driven ships, undertaken at the request of Messrs. Workman, Clark, Ltd., Belfast.

He patented a "Nodal" arrangement which eliminated vibration and which was applied to many famous ships. A fine tribute to this work was paid by Prof. A. L. Mellanby of Glasgow in a recent address to the Institution of Mechanical Engineers, entitled: "Fifty Years of Marine Engineering". During the War of 1914–18 he reorganized the College workshops and a large quantity of valuable munitions was produced.

Prof. Smith took a leading part in cementing the union between the Technical College and Queen's University, Belfast. He built up an excellent degree course in his department, and many of his students proceeded to investigations leading to higher degrees under his direction. He retired in 1938, and Queen's University showed its recognition of his outstanding work in engineering by conferring on him the honorary degree of doctor of science.

As a teacher Smith was in a class by himself, and his passing will be regretted by that large band of engineers who during a period of thirty-three years were enabled to benefit from his lectures.

F. V. WARNOCK.

Viscount Wakefield, G.C.V.O., C.B.E.

By the death on January 15 at the age of eighty-one of Viscount Wakefield, the world has lost an industrialist and philanthropist whose benefactions, apart from support to hospitals and similar institutions, have played a considerable part in the development of aviation. Early in the century he was urging the importance of aviation, both commercially and in other spheres, to the British Empire, and he gave financial support to long-distance flights between various points in the Empire, notably those by Sir Alan Cobham from Great Britain to Australia and back, and those to Cape Town and back by Mollison and by Miss Amy Johnson, whose death occurred on January 5 last. It would be a grave error to look upon these flights as simply attempts at record breaking. They were planned with the project for linking up the Empire by air in mind, and they involved long and intensive preparation and investigation, in design and other directions, the fruits of which are of permanent value.

Lord Wakefield also supported aeronautical studies through the Institution of Aeronautical Engineers, of which he was an honorary member, by the gift of an annual gold medal for the best invention relating to safety in flight; and he established Wakefield Scholarships at Cranwell for R.A.F. cadets.

In the allied fields of motoring and motor-boat racing, Lord Wakefield gave generous aid, which again, though directed in the first place to the achievement of new records, has had a significant influence on design from the point of view of efficiency.

Among Lord Wakefield's other benefactions may be mentioned the reconstruction of the rooms of the British Academy at Burlington House, a guarantee, originally anonymous, of £50,000 to the trustees of the British Museum to enable them to purchase the Codex Sinaiticus, and a gift of £25,000 in aid of the Empire research work of the Imperial Institute.

Mr. F. W. Young, C.B.E.

THE death is reported of Mr. Frank W. Young, lately of the Department of Education for Scotland. Mr. Young, who was in his ninetieth year, was a native of Dundee and studied at the Royal College of Science in the days of Tyndall, Huxley and the elder Frankland. In 1877 he was appointed science master in the High School, Dundee. In those days systematic teaching of science in schools was an innovation, and the laboratory which Young established must have been one of the first school science laboratories, if not the very first, in Scotland. He had an almost boyish enthusiasm for his subject, which quickly won the hearts of the boys whom he taught, and not a few of them afterwards adopted a scientific career.

Among the more distinguished of his pupils were the late Sir James Walker, professor of chemistry in the University of Edinburgh, Prof. Alexander McKenzie, emeritus professor of chemistry in the University of St. Andrews (University College, Dundee), and Dr. W. T. Calman, formerly keeper of zoology in the British Museum (Natural History). In 1900 he was appointed one of H.M. inspectors of schools, and from then on he exercised a very great influence on the development of science and technical teaching in Scotland. While in Dundee he was one of the founders of the Dundee Association for the Promotion of Technical Education, which later became merged in the Scottish Association for Technical Education, of which he was the first honorary secretary. In 1917 he was appointed to take charge of the scheme for the training of ex-Service men in the universities and technical colleges of Scotland. He retired in 1924. One of his "old boys" who passed through his class-room well over half a century ago writes: "Frank Young was a great administrator, whose work has left its mark on Scottish education, but I think he was still greater as a schoolmaster. I have not met more than two or three scientific men who seemed to me to have his aptitude for teaching boys."

WE regret to announce the following deaths:

Dr. E. Baker, the author, and former director of the University of London School of Librarianship, on January 18, aged seventy-one.

Mr. H. W. Macrosty, O.B.E., president of the Royal Statistical Society, and formerly of the Board of Trade, on January 19, aged seventy-six.

Lieut.-Colonel J. M. Mitchell, formerly secretary of the Carnegie United Kingdom Trust, on December 25, aged sixty-one.

Mr. F. T. Paul, a distinguished surgeon and emeritus professor of medical jurisprudence in the University of Liverpool, a past president of the British Medical Association, on January 17, aged eighty-nine.

Prof. Miles Walker, F.R.S., emeritus professor of electrical engineering in the University of Manchester, on January 22, aged seventy-three.

NEWS AND VIEWS

Paper from Straw

THE production of paper from straw both as a war- and peace-time measure is discussed by Dr. Julius Grant in the *Journal of the Ministry of Agriculture* (**47**, 172). For a material to be a suitable substitute for wood pulp, it must be available in large quantities at a reasonable cost and give a good quality paper without requiring any complicated processing. As a war-time consideration it is also important to be able to carry out the processing in existing equipment. On the first two scores straw seems eminently suitable, particularly in view of the increasing acreage now being devoted to cereal growing. As regards quality, the paper produced is rather brittle and lacks bulk; but these disadvantages are to some extent offset by its opacity and good printing qualities. Much depends on the cleanliness of the straw, as foreign material, such as weeds, cause serious deterioration in the quality of the paper produced. Some technical difficulties still need to be overcome, and at present only mills equipped for dealing with esparto cellulose could be used.

It seems likely that straw will continue to be used as a war-time measure, and it is estimated that this type of cellulose, supplemented by rags and waste paper, will serve to supply some 65 per cent of Great Britain's pre-war requirements. The prospect for the more distant future is necessarily uncertain, as it will depend on economic considerations arising out of the international situation that prevails, but it is evident that a unique opportunity may await both the farmer and paper-maker if co-operative research is systematically carried out. It will be recalled that Dr. Grant contributed an article on this subject to NATURE of August 17, 1940 (p. 219).

The United States and the Democratic Ideal

THERE can be no doubt that for future generations Mr. Franklin D. Roosevelt's inaugural address on entering upon his third term of office as President of the United States at Washington on January 20, will be the culminating point of the rally in defence of democracy against aggression. For those generations, indeed, it may even mark the turning of the tide in the present momentous struggle on behalf of freedom. The President, speaking both to and for the American people as their elected representative, stated that "if the spirit of America were killed, even though the nation's body and mind, constricted in an alien world, lived on, the America we know would have perished". This was his warning in face of those who believe that democracy as a form of government and frame of life "is limited or measured by a kind of mystical and artificial fate—and that tyranny and slavery have become the surging wave of the future, and that freedom is an ebbing tide". While the President made no direct allusion to the part the United States is taking and will continue to take in support of the Allies, but spoke, as the occasion constrained him to do, only of the threat to American democracy, the implication of the fate which awaits mankind if America, the final stronghold of the democratic ideal, fails in preparedness, was clearly in his mind. His faith, however, in the ability of democracy to meet the onrush of "the surging wave" rests upon an assured basis. "Democracy," he said, "is not dying"—and fortified by the experience of its resilience in the crises through which the people of the United States have passed in recent years, he declared it to be "the most unconquerable of all forms of human society".

Once again the President stressed the character of America as "the New World", the continent upon which all who came to its shores believed they could create there a new life that should be new in freedom, and showed how this concept of freedom has moved forward constantly and consistently in the history of the United States, as an ideal which has gained in stature and clarity in each generation. He also dwelt upon the fact that the democratic aspiration is no recent phase in human history, but "permeated the ancient life of early peoples, blazed anew in the Middle Ages, and was written in Magna Charta". This is a topic upon which Mr. Roosevelt might well have enlarged in another context. His words would have come home with double force to the British people at a moment when a unique cultural pact had been made recently with the Greek people as they were renewing the glories of their ancestors in resistance to aggression and a devotion to freedom which has persisted through the ages notwithstanding centuries of repression. Dr. Ernest Barker has reminded us lately that we English are forgetting our Greek. Though this be admitted even with reluctance and regret, the newly established cultural relation between Greece and Great Britain will serve constantly to renew our remembrance of the immeasurable debt of the English way of life and thought to ancient Greece. Its influence has been all pervading, not least in fostering the scientific spirit of free inquiry, since the time when the great English scholars of the Renaissance, More, Colet, Ascham and others, brought the new learning to their countrymen and made them members in understanding of that comity of freedom among European peoples which it is now the aim of Nazi aggression utterly to destroy.

Science and Military Service in the United States

IN a joint statement by the U.S. National Research Council and the Subcommittee on Military Affairs of the National Committee on Education to Dr. C. A. Dykstra, director of the Selective Service System, students, research workers and teachers in scientific and professional fields that make vital contributions to national defence should be given deferred classification under the Selective Service Act. The men of science consulted by Dr. Dykstra list six scientific fields in which work is being done of such importance that

in their opinion the workers are doing more toward national defence than if they were on active military service. These are: medicine and allied professions, biological sciences, chemistry, physics, geology and related earth sciences, and engineering in all its branches. Commenting on the desirability of such deferments, the committee points out: "Experience of every nation engaged in the World War and the conditions under which the present conflict in Europe is being waged point directly to the necessity for proper employment of scientific personnel and of those competent to train such personnel, to a continuous supply of newly trained personnel, and to the penalties incident to assigning them in large numbers to purely military service where others without their special training can function equally well."

Particular stress is laid on the desirability of permitting students in such fields as medicine, dentistry, and pharmacy to finish their courses before they take up their military duties, because of the large demand for trained men in both the military and civil sectors, and because intensive specialized training cannot make up for a deficiency of qualified personnel. In all six fields, the statement continues, university presidents should request deferment of members of the teaching staff who in their judgment are essential properly to maintain the efficiency of the institution in the continuous training of students necessary in the operation of the defence programme or in the effective conduct of research and development problems assigned to the institution in connection therewith. The industrial laboratory and some graduate schools employ trained personnel often in group or team operations which require not only highly skilled individual scientific workers and engineers but likewise men accustomed to working together in close co-operation. Subtraction of a single key man from such a group may seriously handicap or even substantially destroy the efficiency of the group to function. The problem of the industrial and university research laboratory concerned with a present or prospective defence programme is not only one of retaining an adequate number of highly trained research men, engineers and skilled technicians, but also one of maintaining the integrity of research and development teams. This is because industrial research and development is a co-ordinated group activity. Research directors should request deferment of highly qualified men whose training and experience are such that their withdrawal will cripple the ability of the laboratory to function effectively in the defence programme.

Engineering Courses for Students in H.M. Forces

IN the December issue of the *Journal* of the Institution of Civil Engineers and in that also of the Institution of Mechanical Engineers, there are announcements regarding the plans which are being made to provide technical instruction for engineers serving in the Fighting Forces. During the War of 1914–18, there was a break in the studies of a whole generation of engineers, with the most serious consequences to the profession and to those young men who, on attempting to resume their training, had difficulty in pursuing their studies and in passing the qualifying examinations. They were, in so many cases, severely handicapped at the most vital stage in the making of their careers. The two Institutions mentioned and the Institution of Electrical Engineers are co-operating with the Board of Education and the Council for Education in the Forces in the organization of courses in engineering subjects.

Curricula of work suitable for guided reading or correspondence courses are now in preparation in some sixteen subjects and are to be of a standard in accordance with the examination requirements of the three Institutions. The subjects chosen are those which have proved most popular among candidates, but it is indicated that other subjects could be included if there is a sufficient demand. There is a suggestion, too, that the new arrangements will provide the means of keeping abreast with their studies for those who were following courses leading up to National Certificates. Relaxation of the 'cast-iron' system on which these certificates are founded will, however, be necessary, or otherwise candidates will find themselves on demobilization barred from both examination and reward by lack of some qualifying percentage of attendance or other ephemeral aspect of training.

The announcements make it clear that while in some respects the serious educational position into which we are drifting is realized, it is only being tackled on the more spectacular side. Here it should be noted that the prime movers are not the critically interested parties, the Board of Education and the professional institutions. The scheme has been initiated by the Council for Education in the Forces. This has the disadvantage that, the arrangements being exclusively for those serving in the Forces, the organization is powerless to assist others. It must be well known, however, that there are many thousands of young men in the engineering industry who, in these days, cannot pursue their studies in the ordinary way. This is a class of student whose progress is seriously hindered by any break in his course of study, as is made clear by the regressive effect of the summer vacation. New systems of education cannot be brought into working order at short notice, and, if not taken in hand now, the position in three years' time will be considerably more serious than in 1919. It is to be hoped, therefore, that a more enlightened policy may emerge, charged with greater sympathy for the difficulties of the younger generation of engineers.

Science and Government

AT a meeting of the Watford Branch of the Association of Scientific Workers held jointly with the University College Hospital Medical School Socialist Society on January 23, Prof. J. D. Bernal spoke on "Science and a New World Order". Prof. Bernal made a survey of the present relations of science with government, particularly dealing with the position of advisory committees. Since the processes of Nature (in the widest sense) are intract-

able and do not obey the fiat of politicians, men of science, who understand these processes, are consulted by the politicians. By the application of modern scientific techniques such as the method of sampling, it is possible for the man of science to discover and understand the processes of society, and determine the needs of the people and the way in which they will react to certain new conditions. But at present these findings are only put into practice by a Government in so far as they do not conflict with the policy of that Government. By the neglect of this advice, however, the Government, while achieving immediate ends of its own, is running counter to the real development of society.

In the discussion which followed Prof. Bernal's paper, it was made clear that a Government based on science can only be put in power by an electorate informed of and appreciating the power of science and scientific method. The corollary to this is that every scientific worker of goodwill has to take on the role of agitator (used in the best English sense) and make public this revolutionary side of science. The Press and the B.B.C. should increase the portion of time devoted to science. Most important, however, must be the personal approach of scientific workers to local organizations such as trade unions, women's guilds and adult education movements. This activity is of the greatest urgency, and it will not do to wait until the end of the War is in sight.

A Horticultural Centenary

THE *Gardeners' Chronicle* entered upon its second century of publication with the issue of January 4. This war-time centennial birthday was marked only by an editorial of restrained dignity and a plate of the four founders with their first-born journal. Such attenuated celebration was necessitated by the large number of articles upon food production, which the *Chronicle* has fostered consistently since the outbreak of hostilities. Horticulture, with its roots in the activities of the first civilized man, had attained a considerable development by Roman times, but remained technically moribund until the beginning of last century. The static condition became, indeed, less profound in the Elizabethan epoch; but it was not until the nineteenth century that gardeners gave practical expression to their curiosity by searching the globe for new plants, by experimenting with the art of forcing, by erecting greenhouses, discovering new manures, crossing plants for new horticultural excellence, and keeping diseases and pests under control. The *Gardeners' Chronicle* was the journalistic crystallization of all this new development.

It was founded by a quartette of gentlemen, each of whom played his part in transporting horticulture from its shackles of feudal tradition into the noble combination of scientific art. Sir Joseph Paxton, Wentworth Dilke, John Bradbury and John Lindley united to initiate the journal, with Lindley as its first editor. The same group founded *Punch* and the *Athenæum*, also in 1841. John Lindley was a man of abundant energy, with a thorough knowledge of practical gardening, a profound knowledge of botany, and a talent for literary expression. His classical work "The Theory and Practice of Horticulture" collected the sum total of garden knowledge, and he began a line of practical but scientific editors whose title to write was a mandate from personal experience. Lindley was succeeded as editor by Maxwell T. Masters, famous for his work on plant teratology, and for his presidency of the Scientific Committee of the Royal Horticultural Society. Prof. (now Sir John) Farmer, carried on the editorial tradition for a few years and was succeeded by Sir Frederick Keeble, who has taught the present generation how "Science lends a Hand in the Garden", in an entertaining volume recently published. Sir Frederick is still scientific adviser, but the duties of editor have devolved in succession upon the late R. Hooper Pearson and Charles H. Curtis.

The *Gardeners' Chronicle* states simply and clearly the way to grow plants, but it has always attracted the scientific writer. Geo. Massee and M. C. Cooke, among the great mycologists of last century, frequently published in its pages, enriching the science of plant pathology from their experience of field mycology. More modern times have brought no less fundamental contributions, and in recent numbers readers will find a continuous series of articles on "The Garden in War-time", where the merits of various crops are considered from the point of view of food production. "Possible Sources of Organic Matter" are discussed by T. Laflin (Jan. 4 and 11); these include the residues from several industries, like bark scrapings, textile wastes and leather meal. Experiments on "Vernalization of Tomatoes" by D. W. Goodall and B. D. Bolas (Dec. 28) show promising results of increased fruit yield from chilling the seed, followed by incubation at 14° C. before sowing. W. A. Millard contributes a photograph of a potato tuber attacked by the destructive forest parasite *Armillaria mellea*, the honey fungus. Thus the century-old tradition of a blend of science with practice is maintained, while from both men of science and gardeners come best wishes for the centuries that lie ahead.

Journal of the Institution of Electrical Engineers

WITH the January issue the *Journal of the Institution of Electrical Engineers* appears in a new form. In a foreword to the new journal, Mr. J. R. Baird, the president, says that he feels sure that the change in form of the *Journal* has much greater justification than merely saving paper and preventing undue increase in the cost of publication. For some years past it has been increasingly felt that much of the material in the *Journal* has tended to become of a highly specialized character and therefore of interest only to limited sections of the membership. The new arrangement recognizes this difficulty by subdividing the *Journal* into three parts. Part I is designed to include all matters likely to be of general interest to all members, including abstracts of all papers and "Institution Notes", through which members will be kept informed of the activities of the Institution. It is to be issued monthly and all members will receive

it free. Parts II and III will include in full all specialized papers on "Power Engineering" and "Communication Engineering" respectively, thus giving recognition to the two main fields of electrical engineering activity. For these two parts members must apply specially and a small additional charge is to be made; Part II will appear in alternate months and Part III quarterly. Free advance copies of papers accepted for reading at meetings will still be available. Part III incorporates the *Proceedings of the Wireless Section*, and also includes papers on telegraphy and telephony; these are comparatively few and will probably be of interest to members of the Section. The new feature which has been introduced into Part I, of giving abstracts of all papers which are published in Parts II and III, will, it is felt, be of considerable value to all members.

Earthquake in Cyprus

On January 20 at about 5.40 a.m. local time, an earthquake of considerable severity occurred, shaking the whole island of Cyprus for about half a minute. The epicentre of the earthquake was probably in the neighbourhood of the port of Famagusta, where forty-four houses are reported to have collapsed and other buildings damaged. The Cathedral of St. Nicholas was slightly damaged. Seven people are reported injured. At Nicosia some houses and one or two churches were cracked by the earthquake, though here no casualties are mentioned in reports so far received.

The Night Sky in February

During this month, the night shortens by nearly two hours in the latitude of London. The moon is full on February 12 and new on February 26. Lunar conjunctions with Jupiter and Saturn occur on February 3 at 19h. and 21h. U.T. respectively. The moon is in conjunction with Mars on February 21 at 3h., the moon rising that morning at 3h. 47m. at Greenwich. Jupiter and Saturn still continue in close company, just within the southern limit of the constellation Aries, and they reach conjunction with one another on February 20 at 19h. On that day they come to the southern meridian at Greenwich at 16h. 30·4m. Thereafter, Jupiter draws away eastwards from Saturn. The distant planet, Uranus (seen as a 6th magnitude star but with a true disk 3½″ in diameter), is just within the western border of Taurus, in a region south—preceding the Pleiades and devoid of stars as bright as the 6th magnitude. At the time of the planet's discovery in 1781 by Sir William Herschel, Uranus was in the neighbouring constellation of Gemini. By using a large range of powers (from 230 to 2000), Herschel was convinced from a telescopic examination alone that the object, called by him at first a 'comet', was definitely not one of the fixed stars. In mid-February at about 20h., Orion comes to the southern meridian. Light changes of the variable star Algol (β Persei), may be observed about 1½ hours before and after the following times: February 9d. 4·9h.: 12d. 1·7h.: 14d. 22·5h. and 17d. 19·4h. U.T. (add 1h. to reckon in Summer Time).

Announcements

The Council of the Geological Society has made the following awards: Wollaston Medal to Dr. A. L. Day, of the Geophysical Laboratory, Washington, D.C.; Murchison Medal to Dr. Murray Macgregor, of H.M. Geological Survey (Scotland); Lyell Medal to Mr. Ernest Sheppard Pinfold; Bigsby Medal to Dr. C. J. Stubblefield, of H.M. Geological Survey; Wollaston Fund to Dr. K. P. Oakley, of the British Museum (Natural History); Murchison Fund to Dr. John Weir, of the University of Glasgow; a moiety of the Lyell Fund to Mr. W. Eltringham; another moiety of the Lyell Fund to Dr. F. S. Wallis, of the Bristol Museum and Art Gallery.

The Buchan Prize for 1941 of the Royal Meteorological Society has been awarded to Mr. H. L. Wright for papers contributed to the *Quarterly Journal* of the Society during 1935–39.

The Chadwick Trustees recently offered two prizes of £100 and £50 for essays on the construction and management of air raid shelters, with special reference to ventilation, heating, sanitation and the provision of sleeping accommodation. The prizes have been awarded as follows: £100 to Mr. Phillip O. Reece and Dr. S. L. Wright, of Wembley, Middlesex; £50 to Mr. Jocelyn F. Adburgham, of Victoria Street, Westminster, S.W.1.

A Neurological Section has recently been added to the Caroline Medical Institute in Stockholm, the principal medical school of Sweden, under the direction of Prof. Ragnan Granit, an international authority on electro-physiology.

The following appointments have recently been made in the Colonial Service: G. L. Bannister, veterinary officer, Tanganyika Territory; J. D. Birkett, veterinary officer, Nigeria; R. W. E. Lewis, veterinary officer, Kenya; I. B. Pullon, veterinary officer, Tanganyika Territory; D. S. Davies (senior agricultural officer, Uganda), deputy director of agriculture, Palestine; H. R. Hosking (botanist), senior botanist, Uganda; J. D. Jameson (agricultural officer), botanist, Uganda.

Mr. T. H. Hawkins, education officer of the Educational Advisory Board of the British Social Hygiene Council, is resigning his position, in any event for the duration of the War and possibly permanently. The War Emergency Committee of the Educational Advisory Board has been actively promoting both the School Leavers' Courses and the lectures to young people. The education officer is responsible for the administrative work relating to the Educational Advisory Board, the printing and issue of *Biology* under the direction of the editor, conferences and courses of lectures to teachers on the teaching of biology relating to human problems, and short courses of instructional lectures on the place of sex in life to the 16–23 age group. Applications are invited for this post. Further information can be obtained from the Acting Secretary, the Educational Advisory Board, Tavistock House South, Tavistock Square, W.C.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Hand of the Sterkfontein Ape

WHEN describing the hand bones of the fossil people of Mount Carmel[1], Dr. T. McCown and I had to make a close study of the os magnum (capitatum) of man and ape. We observed that the os magnum of the Bushman had certain distinctive features. Dr. Broom, in his account[2], gives an outline of the Sterkfontein carpal, placing it between corresponding views of the carpals of modern Bushmen. So like is the Sterkfontein os magnum to the Bush specimens, and so unlike is it to those of other races of man and ape, prehistoric and modern, that I regard the Sterkfontein bone, not only as being human, but also as representing a prehistoric Bushman. If I am wrong in this inference, then we have to accept Dr. Broom's supposition that the Sterkfontein ape had a truly human hand—one modelled on the small and delicate lines of a Bushwoman.

ARTHUR KEITH.

Buckston Browne Farm,
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Jan. 21.

[1] "The Stone-Age of Mount Carmel. The Fossil Human Remains from the Levalloiso-Mousterean", vol. 2, chapter x (1939).
[2] NATURE, **147**, 86 (Jan. 18, 1941).

The Extra Spots in Laue Photographs

THE existence of diffuse spots in X-ray crystal photographs which do not belong to the Laue pattern has now been established[1,2,3,4,5]. Explanations of the extra spots have been proposed by Preston[1], Zachariasen[6], and Raman and Nath[7]. Following Preston's suggestion that the crystal is broken up into small groups of atoms by thermal agitation, Sir William Bragg[8] has recently derived a formula for the intensity of X-rays scattered from a group of eight point atoms arranged at the corners of a cube of edge a. This formula may be written in the form

$$\frac{\sin^2 nA}{\sin^2 A} \cdot \frac{\sin^2 nB}{\sin^2 B} \cdot \frac{\sin^2 nC}{\sin^2 C}, \qquad (1)$$

where $n = 2$.

Formula (1) is also that for a simple cubic lattice with n point atoms on an edge where n may be a large number. For simplicity, we shall consider the case where one edge of the cube is normal to the plane of scattering. The intensity of the scattered rays in this plane is then proportional to

$$\frac{\sin^2 nA}{\sin^2 A} \cdot \frac{\sin^2 nB}{\sin^2 B}, \qquad (2)$$

where $A = (2\pi a/\lambda)\sin\frac{1}{2}\varphi \sin(\frac{1}{2}\varphi - i)$, $B = (2\pi a/\lambda)\sin\frac{1}{2}\varphi \cos(\frac{1}{2}\varphi - i)$, a being the distance between two adjacent atoms on an edge, i the glancing angle of incidence of the X-rays on a cube face which is normal to the scattering plane, and φ the angle of scattering. The principal maxima of (2) occur when $A = h\pi$ and $B = k\pi$, where h and k are integers. This holds for all values of n greater than unity. Let φ and i assume the respective values φ_B and i_B for given h and k. Let the cube be turned from the position $i = i_B$ to $i = i$. With i fixed at the new value, (2) is differentiated with respect to φ in order to find the position of the secondary maximum. It is found that, for small values of $(i - i_B)$, the position $\varphi = \varphi_{mB}$ of the secondary maximum is given by

$$\varphi_{mB} - 2\theta_B = 2(i - i_B)\sin^2\theta_B, \qquad (3)$$

where $\theta_B = \frac{1}{2}\varphi_B$.

It is astonishing that (3) has also been derived by Zachariasen[6] and by Raman and Nath[7] on assumptions quite different from those in this letter. In order to test the degree of approximation of (3), the expression (2) has been plotted against φ for the case $\theta_B = 59° 40'$, $i_B = 41° 15'$ (corresponding to the 620 Bragg reflection of copper $K\alpha_1$ rays from rocksalt), and $(i - i_B) = 5°$. As nearly as one can tell from the graphs, the position of the maximum intensity of the modified Bragg spot is given by (3) for $n = 2$, 3, 4, 5. Equation (3), however, breaks down for $n = 6$. Further discussion of this matter will appear in the *Physical Review*.

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Dec. 21.

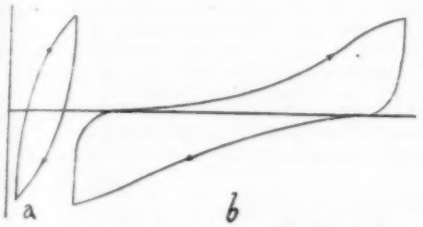
[1] Preston, *Proc. Roy. Soc.*, A, **172**, 116 (1939).
[2] Raman and Nilakantan, *Proc. Ind. Acad. Sci.*, **11**, 379 (1940).
[3] Siegel and Zachariasen, *Phys. Rev.*, **57**, 795 (1940).
[4] Lonsdale, Knaggs, and Smith, NATURE, **145**, 332 (1940).
[5] Jauncey and Baltzer, *Phys. Rev.* (December 15, 1940).
[6] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).
[7] Raman and Nath, *Proc. Ind. Acad. Sci.*, **12**, 83 (1940).
[8] Bragg, NATURE, **146**, 509 (1940).

Stress-Strain Hysteresis in Certain Clays and other Substances

IN a recent article, V. G. W. Harrison[1] briefly discussed various rheological properties of the materials which lie between solids and liquids. Considerations of space probably prevented him from mentioning one of the most interesting aspects of this subject, the exhibition in common of one particular property by otherwise totally dissimilar substances.

Certain clays, when in the plastic state, possess a curious property which does not seem to have received previous recognition. If a portion is held in the fingers of both hands, and alternately pulled

and compressed, there is a range of easy movement culminating in a sudden resistance. A stress-strain hysteresis loop of such material between equal positive and negative stress values (compared, in the accompanying diagram, with a similar loop on a normal clay) shows appreciable movement at low stresses. The property, by analogy, might be called 'backlash', and the criterion for its appearance in clays appears to be that the mineral shall have been commercially prepared by a sedimentation process. Thus the china clays behave in this manner, though in comparatively small degree. A rather exceptional fireclay, which is settled out from the washings of another refractory material, exhibits this property very marked'y. In common with the china clays, it has poor plasticity and an exceptionally high 'aqueous conductivity', that is, under comparable conditions it permits the flow of water through it at a rate approximately one hundred times greater than that normally found. This is probably due to the removal, during the sedimentation process, of the finest particles.



a. Normal type of stress-strain hysteresis loop for clay.
b. Hysteresis loop of a clay showing 'backlash'.

Harrison mentions the remarkable increase on stirring in the viscosity of suspensions of rice starch in water. At certain concentrations, normally liquid, these can be picked up as a solid, and it has been found that in this condition the suspension also possesses a high degree of 'backlash'.

The chain molecule will account for the behaviour of the starch, but the viscosity of a clay suspension, in general, decreases with rate of shear. The thixotropy of china slips is small, but this difference makes it seem unlikely that any supposition of chain formation will prove a satisfactory explanation of their behaviour. The generally accepted alternative is that a repulsion exists between the surfaces of the clay particles, which thus appear to be separated by water films. 'Backlash' is then due to a sliding of the flat particles relative to one another. In the vast majority of clays, which do not show this effect, the presence of the finer particles in the interstices between the larger, that is, better 'packing', would prevent this movement.

It is possible that more common rheological phenomena, such as thixotropy, may be due, in different substances, to fundamentally different mechanisms, and thus require different treatment, both experimentally and theoretically.

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[1] NATURE, **146**, 580 (1940).

Association between Nitrogen-fixing and Cellulose-decomposing Micro-organisms

IT is a well-known fact that by the combined action of cellulose-decomposing and nitrogen-fixing bacteria in crude culture, elementary nitrogen may be fixed in quantities of as much as 10–12 mgm. per gm. of decomposed cellulose. So far, only Vartiovaara[1] seems to have given indisputable proof of nitrogen-fixation in combined cultures of one nitrogen-fixing and one cellulose-decomposing organism (Azotobacter; *Clostridium pasteurianum*, cellulose-decomposing fungi).

Experiments by us have shown that no nitrogen is fixed when Azotobacter is grown in association with pure cultures of 'typical' aerobic cellulose-decomposing bacteria (Cytophaga, Cellvibrio, etc.) as well as fungi or Actinomycetes. However, certain facultative aerobes of the genus Corynebacterium were able to supply Azotobacter with food material from cellulose, which was decomposed with the formation of organic acids[2]. Further experiments showed that the yield of fixed nitrogen could reach as much as 14 mgm. N per gm. of decomposed cellulose. This maximal efficiency was observed only under restricted access of oxygen; under fully aerobic conditions the yield of fixed nitrogen did not exceed 2 mgm. N per gm. of cellulose, and the production of soluble organic substances from the cellulose was less than under restricted aeration. These organic by-products were partly volatile acids (formic and acetic), partly non-volatile compounds including small amounts of lactic acid, besides certain unknown constituents which could be utilized by Azotobacter with an efficiency comparable to that of glucose; most of the nitrogen was fixed at the expense of the non-volatile decomposition products. When Azotobacter was grown in filtrates from cellulose-cultures the yield of fixed nitrogen did not exceed 6 mgm. per gm. of decomposed cellulose; we observed that Azotobacter, when grown in association with the cellulose-decomposers, exerts a depressing influence on the oxidation-reduction potential and in this way probably encourages the formation of organic by-products from the cellulose.

Finally, we have found that the anaerobic *Clostridium pasteurianum*, unlike Azotobacter, is able to fix nitrogen in association with strictly aerobic cellulose-decomposing bacteria (Cellvibrio). This process may yield up to 7 mgm. of fixed nitrogen per gm. of decomposed cellulose, and is accompanied by a decline in the oxidation-reduction potential to the level characteristic of anaerobic bacteria, namely, $Eh = -0{\cdot}35$ to $-0{\cdot}40$ volt.

It thus appears that nitrogen fixation on the basis of cellulose requires either a recurrent exclusion of oxygen, as found by Vartiovaara[1], or else the co-operation of at least one anaerobic component in the microbial association, since a certain degree of anærobiosis is necessary for a sufficient production of soluble organic substances from the cellulose. This explains why no significant amount of nitrogen is fixed in moderately moist soil with addition of cellulosic materials, as recently found by one of us[2]. Therefore, the most favourable conditions for gains of nitrogen by co-operation between nitrogen-fixing and cellulose-decomposing bacteria would seem to exist in heaps of decomposing plant material and in

soils frequently subject to waterlogging, rather than in well-aerated agricultural soils such as, for example, in most of the wheat-producing areas of Australia.

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Nov. 18.

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A Quantum Yield for the Inactivation of Tobacco Mosaic Virus Protein

THE properties of crystalline tobacco mosaic virus protein serve to make it a most interesting substance for photochemical investigation. Its photo-inactivation by ultra-violet radiation has been demonstrated by several workers[1,2], who have reported a monomolecular reaction for the process, thus indicating that the absorption of a single quantum is sufficient to bring about inactivation of this gigantic molecule. However, the quantum yield of this reaction has never been determined, although it is now possible to do so from existing data by assembling the necessary information from several sources. This calculation will now be made.

The essential inactivation data are contained in a paper of Price and Gowen[1], who exposed a solution of crystalline virus protein having 9·65 mgm. of protein nitrogen per 40 cm.³, in a layer 0·052 cm. thick, to the total radiation output of a 110-volt mercury arc. They found that an average incident dose of 48,900 ergs/mm.² inactivated 50 per cent of the solution, as shown by inoculation tests on young bean plants. Using Stanley's[3] value of 16·4 per cent for the nitrogen content of the virus protein, the concentration of the original solution is calculated to be $8{\cdot}65 \times 10^{-9}$ mols/litre. The number of molecules inactivated per cm.³ is then found to be $2{\cdot}62 \times 10^{13}$.

The absorption spectrum of the crystalline virus protein has been measured by Lavin and Stanley[4], who found it to have a maximum molecular extinction coefficient of 8×10^7 at 2650 A. on the basis of a molecular weight of 17,000,000. This absorption curve paralleled approximately the spectral inactivation curve of Hollænder and Duggar[2], indicating that the quantum yield is independent of wavelength and that only wave-lengths less than 3000 A. are appreciably effective. From unpublished data of B. T. Barnes of the General Electric Development Company on the type of mercury arc used by Price and Gowen, it is computed that the emission of radiation in the effective wave-length region comprised only 20 per cent of the total output of the source.

The incident radiation in the effective wavelength range for 50 per cent inactivation of the virus is found to be 978,000 ergs/cm.², of which 54 per cent is absorbed in a layer 0·052 cm. thick. The fraction absorbed is calculated on the basis of an average molecular extinction coefficient of $7{\cdot}5 \times 10^7$ and a concentration of $8{\cdot}65 \times 10^{-7}$ *M*. Inasmuch as the original concentration of the active virus protein decreased by 50 per cent during the irradiation, the averaged value for the energy absorbed by the *active* molecules is only 72 per cent of the total energy absorbed by the solution, or $7{\cdot}3 \times 10^4$ ergs/cm.³. At λ2650 A., the corresponding number of potentially effective quanta absorbed per cm.³ is $98{\cdot}7 \times 10^{16}$. Since the number of molecules inactivated per cm.³ was found to be $2{\cdot}62 \times 10^{13}$, the quantum yield turns out as 0·000026.

In other words, only one absorbed quantum out of nearly 40,000 is actually effective in inactivating a virus protein molecule. Although it is realized that this value is the result of several approximations, yet it is probably of the correct order of magnitude. Its meaning is not entirely clear, however, owing to the uncertainty in the molecular weight. For example, if the molecular weight of the active virus molecule were only a tenth as great, then its quantum yield would be ten times as high as that just calculated. In any event, the yield appears to be a very low one.

Quantum yields for the denaturation or inactivation of high molecular weight proteins are known for only a few cases. A recent determination by Landen[5] gave yields varying from 0·0009 at λ2537 A. to 0·009 at λ1849 A. for the inactivation of crystalline urease (mol. wt. 483,000). The inactivation of pepsin (mol. wt. 36,000) by Gates[6] led to a maximum of 0·0014 for the quantum yield at λ2357 A. (as calculated by Landen[5]) with much lower values for longer wavelengths. Thus the yield value for the virus protein is seen to be smaller and, compared to urease, inversely proportional to the molecular weight.

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Dec. 16.

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Physiological Condition of Anthocyanins in Etiolated Seedlings

SECONDARY products of plant metabolism, such as alkaloids, essential oils, anthocyanins, etc., have been generally looked upon as being definitely eliminated from any further metabolic processes in the plant. Investigations that are now being made with the view of ascertaining the genesis of anthocyanins have led to results that prove the contrary. If, for example, seeds of red radishes (*Raphanus sativus*), or red cabbage (*Brassica oleracea capitata rubra*), are left to germinate on sand, anthocyanins will show as early as the first few days following germination, at first in the cotyledons, and later on in the hypocotyls. Now, if those seedlings are subjected to etiolation, their anthocyanins, affected by the metabolic process of etiolation, will disappear. This will be seen with both cool (50° F.) and warm (95° F.) temperatures. The resorption of anthocyanins will take a few days only, at 95° F., whereas at 50° F. the resorption takes several weeks to be completed.

Essential oils of seedlings of *Salvia officinalis*[1] show a physiological condition that is similar: they are resorbed, as well, by the plant the metabolism of which is affected by etiolation. Alkaloids, too, are apt

in be reclaimed by the metabolic process in vegetal organisms. This was found, for example, in the case of hordenine[3], caffeine and theobromine[3], as well as with alkaloids of *Lupinus luteus*[4]. Other groups of secondary products of plant metabolism are expected to show a similar condition (glycosides, tannic substances, etc.).

All this tends to the conclusion that a plant, if necessary, falls back upon its own elimination products; that is, it can utilize, in a way that has not yet been elucidated, its own secondary products of metabolism for the benefit of its physiological requirements in the metabolic process of etiolation.

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Zurich. Dec. 3.

[1] Frey-Wyssling, A., and Blank, F., *Verh. Schweiz. Naturf. Ges.* (1940).
[2] Raoul, Y., *C.R.*, **205** (1937).
[3] Weevers, Th., *Arch. Néerl. Sc. Naturelles*, 111/B, **4** (1930).
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Science and the Unobservable

PROF. KENNARD, in a discussion on the topic "Science and the Observable"[1] remarked: "Recognition of the limited scope of its generalizations and indifference to the unattainable seem to be two of the most valuable traits of the modern scientific method, as contrasted with the speculations of the medieval philosophers."

The implications of the word "unattainable" are not altogether clear. If here or in other similar contexts the implication is that only the "physically" observable is "observable", then it must be said that at the root of this supposition there is an oversight which is extraordinarily common. We *certainly* have other modes of acquiring knowledge of physical events than through the senses and their extensions in the apparatus of the physical laboratory. This oversight is so common that many readers of these words will probably challenge my statement until an evidential example is cited—a very easy thing to do.

I know *now* that within one minute of this instant the sheet on which I am writing will be covered with certain black marks which we call letters. This knowledge of certain physical events presently to come to pass has not reached me through my eyes, my ears, my cutaneous sense, nor by the aid of a microscope or any other physical laboratory apparatus, but through that faculty which I call my *will*.

That a large and important body of knowledge can be built up without mention of or reference to information possessed by the individual in this way is an interesting fact. But assuredly a description of Nature which omits all mention of the type of foreknowledge illustrated in my example is not only incomplete, but also incomplete in a most important respect. To urge all scientific investigators scrupulously to omit this remarkable phenomenon from all their inquiries into physical events cannot ultimately be good advice. Even the physicist will probably err if he entirely omits this phenomenon from his contemplation of Nature; for Nature is a whole, and it is very unlikely that a fundamental understanding of it can be obtained if a part, and a probably very important part, is deliberately excluded from consideration.

If in the past the intervention of conscious action in physical events has received very little attention from physicists, this can scarcely be regarded as a virtue of our present system, but rather as a defect which it may be anticipated the future, possibly the distant future, may in some degree overcome. Certainly the policy of setting up an arbitrary barrier and saying to all investigators "Beyond this ye shall not pass", seems utterly contrary to the very spirit of science.

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[1] NATURE, **141**, 556 (1938).

Renal Injury in *Trichosurus vulpecula* Produced by Œstrogens

A SERIES of five males and five females of the common Australian phalanger or possum (*Trichosurus vulpecula*) of an average body-weight of about 2 kgm. were injected weekly with 2–5 mgm. of œstrodiol benzoate or œstrodiol dipropionate. These animals died or were killed between ten and thirty-nine days after the first injection. At death they all showed a markedly elevated blood urea content (190–500 mgm. per cent). On histological examination the kidneys showed a varying degree of cloudy swelling which frequently was associated with necrosis of the convoluted tubules. In many instances some of the collecting tubules were found to be dilated in their proximal portions. An outstanding observation was calcification involving the epithelial remnants in a few or many of the convoluted tubules. The picture was one of calcification of necrotic epithelium similar to that seen in mercury bichloride poisoning. It was observed in eight out of ten animals. Calcification was also occasionally seen in the muscular coat of small and large blood vessels. In addition, a series of seven animals was injected with a single dose of approximately 1 mgm. per kgm. body-weight of stilbœstrol dipropionate. These animals were killed or died within 2–17 days. With the exception of the animal which was killed two days after the injection, similar functional and histological findings were obtained as in the previous series although calcification was observed in only two out of six animals.

These findings indicate that definite primary renal injury is produced in the marsupial *Trichosurus vulpecula* after the administration of comparatively large doses of œstrogens[1,2]. No animals which developed the later complications, hydroureter and hydronephrosis, were included in this series[3].

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Dec. 12.

[1] Korenchevsky, V., and Ross, M. A., *Brit. Med. J.*, 645 (1940).
[2] Grollman, A., Harrison, T. R., and Williams, J. R., *J. Pharm. Exp. Ther.*, **69**, 149 (1940).
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RESEARCH ITEMS

Unusual Mitosis in a Scorpion

IN 1916, E. B. Wilson described an unusual type of mitosis in the gametogenesis of a scorpion, *Centrurus exilicauda*, in which the chondriosomes of the spermatocyte form a ring. Other scorpions have been investigated since that date, but it has not been found in them. I. Sato (*J. Sci. Hiroshima Univ.*, **8**; 1940) has rediscovered it in the spermatogenesis of the Oriental scorpion, *Buthus martensii*, and studied it by modern techniques, employing a large number of fixatives and staining methods. The material also exhibited other peculiarities, notably in its dictyokinesis. In this paper, illustrated by text-figures and eleven plates—three of them coloured—the author gives a full account of the spermatogenesis and also a comparison of it with the phenomena in other forms. In spermatogonial mitoses the order in which the cell components reach the two poles is: first, Golgi materials, next chondriosomes, and lastly chromosomes. The chondriosome ring in both fresh and fixed material exhibits a clearly marked spiral structure; to these the author has given the name chondrionema. The Golgi bodies are always distinguishable from the chondriosomes, and during early cell growth the former fragment into dictyosomes. The chromosome number is 24 in the diploid and 12 in the haploid state, and the chromosomes are rod-like and similar save for size, and no sex chromosome could be distinguished.

Carbohydrates in Apple Rootstocks

THE relation of carbohydrate changes to dwarfing and vigour in apple rootstocks has been investigated by Y. V. Rao and W. E. Berry (*J. Pom. and Hort. Sci.*, **18**, 193; 1940). They have studied the seasonal and regional distribution of carbohydrates in the current season's growth of a single scion variety grafted on Malling rootstocks IX and XIII. Higher concentrations of carbohydrate were found in the dwarfing stock, and the scions grafted on it, than in corresponding portions of the vigorous tree. Changes in carbohydrate content occurred at different times in the dwarfing and vigorous trees and in particular starch accumulation began several weeks earlier in the *M* IX stock than in *M* XIII. Changes in stock and scion occurred simultaneously in the *M* XIII tree but were to some extent independent in the *M* IX tree. Examination of the gradient of sugars along the stem produced no evidence to support the view that downward movement of soluble carbohydrate is interrupted at the graft union in the IX trees. On the other hand, extensive starch condensation may result in a restricted supply of sugars to the roots. Starch accumulation in both IX and XIII stocks preceded growth cessation in the scions, whereas starch accumulation in the scions occurred simultaneously with cessation of extension growth. The water content of the dwarf tree was found to be less than that of the vigorous tree. This may be the cause of both starch accumulation and growth cessation. The proportion of storage tissue in the *M* IX stock is greater than in *M* XIII, and it is suggested that the early and extensive storage of starch may be the immediate cause of the dwarfing influence of the IX stock.

Improvements in Rubber Planting Material

C. E. T. MANN has recently published a paper on this subject (Comm. 251, *J. Rubber Res. Inst. Malaya*, **10**,) which summarizes the results of ten years studies of specially selected clones of rubber, propagated by budding and now tapped for rubber through this period. The original selections of clones were made by Sanderson and Sutcliffe, scientific officers of the Rubber Growers' Association in Malaya, and budded on to stocks in 1924; in 1927 their further study was taken over by the Rubber Research Institute. With a perennial like Hevea, the period since 1927 only permits a tentative and preliminary estimate of improvement in yield, but of the twenty-one clones originally selected it is now possible to say that two of the clones are first class. After searching tests and under normal tapping conditions, it can now definitely be concluded that all the trees of these clones behave similarly and show a steady development towards a yield at maturity which is almost treble that shown by the average seedling trees planted at the time the clones were first established. The results, which confirm the conclusion of research workers in the Netherlands East Indies, also stress the great value of the uniform product to be obtained from a clone, a result which should readily be accepted in the horticultural home of Cox's Orange Pippin, Ribston Pippin, etc. But Mr. Mann has to report a considerable prejudice still existing among Malayan planters against budded trees as against natural seedlings. The rubber plant will not self readily, so that it is of considerable importance that the studies of legitimate seedlings resulting from artificial crosses between high yielding clones show that such seedlings have a high average yield though the usual variability. Further selection from such material, coupled with further vegetative propagation, holds out still more hopeful prospects for the future.

Spore Discharge in the Mucors

A BRIEF note by C. T. Ingold (*New Phyt.*, **39**, No. 4; Dec. 1940) directs attention to another case where facile assumption seems to have taken the place of direct observation. The turgid columella and thin wall of the Mucor sporangium seemed to speak so clearly of a bursting mechanism followed by spore dispersal in the air that this has been assumed without question. Dobbs, however (NATURE, **143**, 286; 1939), pointed out that when the sporangium of Mucor bursts in air the spores are not set free, a drop of liquid is discharged and the sporangium is replaced by a liquid drop containing still the spores and columella. Now Ingold completely confirms Dobbs for species of Mucor and Thamnidium; in *Rhizopus nigricans* it may liberate air-borne spores, but in the other genera the spores are not set free in the air after the sporangia are burst. The attention of mycologists is thus directed afresh to an unexpected gap in our knowledge of these widely spread moulds. How are the spores dispersed? Ingold suggests in his paper that insects may play a bigger part in dispersal than has been generally supposed.

Submarine Canyons

A. L. DU TOIT has presented (*Geol. Mag.*, 395–404; 1940) yet another hypothesis to account for the remarkable 'submarine canyons' which are now known to furrow the continental margins in so many places; features which almost amount, as he says, to "a colossal joke on the part of Nature". While du Toit concedes that submarine agencies could have contributed materially to the development or maintenance of the stream-like 'ravines', he finds it difficult, like many other geologists, to accept the view that such agencies were primarily responsible for their initiation and excavation. He therefore re-examines the original suggestion, that of subaerial erosion, and points out that since the actual incisions made by the canyons in the Continental Shelf and Slope rarely reach 600 fathoms, a limit of about 4,000 ft. is set to the former maximum uplift of the continental rim which would be necessary to permit such erosion. His scheme for bringing about the sequence of events—expressed in the simplest terms—involves: (*a*) faulting, more or less parallel to the continental margins, accompanied by upward warping on the land side (akin to the 'pseudo-arching' of the plateaux bordering major rift valleys); (*b*) development of gorges through the newly risen coastal barrier and of a consequent drainage system, directed inland; (*c*) further sagging of the adjacent ocean floor, and down-dragging of the rim, with consequent marine abrasion to form the Continental Shelf and concomitant drowning of the canyons. It is frankly admitted that such conjectural elevation of the rim and subsequent downwarping and trans-section strains credulity—but so does every other hypothesis yet proposed. Various consequences of the new orogenic hypothesis are suggested which can be tested by stratigraphers and others.

Nitroxyl Perchlorate

THE halogen derivatives of nitric acid, nitroxyl (or nitryl) fluoride and chloride are of fairly recent discovery, and in view of the existence of a nitroxyl perchlorate, $NOClO_4$, the preparation of nitroxyl perchlorate, NO_2ClO_4, announced by W. E. Gordon and J. W. T. Spinks (*Canadian J. Research*, **18**, 358; 1940), is interesting. The method of preparation consisted in mixing chlorine dioxide with a stream of ozonized air containing oxides of nitrogen. The nitroxyl perchlorate crystallized on the walls of a reaction chamber. Qualitative tests showed that it reacts with water to form perchloric and nitric acids, and the reaction in a Lunge nitrometer gave 9·69 per cent N (theoretical 9·62 per cent). The solid is apparently not spontaneously explosive; but it detonates with benzene, acetone and ether. Rapid reaction without detonation occurs with alcohol and glycerol. With iodine, on warming, iodine pentoxide and (probably) iodine monochloride are formed. The mechanism of reaction is discussed, and it is assumed that, in presence of ozone, NO_2 forms NO_3, and ClO_2 forms ClO_3, which then combine to form nitroxyl perchlorate: $NO_2 + ClO_3 = NO_2ClO_4$.

Vanadium Ion Potentials

THE nature of the 4- and 5-valent vanadium ions in acid solutions has been the subject of researches by different methods, and it has been suggested that the 5-valent vanadium might be present as vanadic acid, HVO_3, or as the univalent cation, $VO_2^{\cdot}$. The 4-valent vanadium is very generally regarded as existing as the bivalent cation $VO^{\cdot\cdot}$ of a vanadyl salt. An electrochemical study of this oxidation-reduction system has been made by A. B. Hart and J. R. Partington (*J. Chem. Soc.*, 1532; 1940), who have measured the potentials of cells containing the given system and a standard electrode. The activities of the components were taken into account, and the conclusion was reached that the electrochemical behaviour in acid solutions is best explained on the assumption that the vanadium exists as the ions $VO^{\cdot\cdot}$ and $VO_2^{\cdot}$. The relation between the electrochemical study and the measurements of solubilities of vanadium pentoxide by Britton and Welford (*J. Chem. Soc.*, 895; 1940) is discussed.

Polarization of Electrons

FURTHER experimental work on the polarization of electrons is described by K. Kikuchi (*Proc. Physico-Math. Soc. Japan*, **22**, 805–824; 1940). The magnetic spectra at azimuthal angles of 0° and 180°, after two 102°-angled scatterings, were examined for various velocities of incident beam, using two similar Geiger electron counters and an oval-shaped electro-magnet having two gaps. The polarizer consisted of comparatively thick gold foil. The analyser was 8×10^{-4} cm. thick. In comparing the total area of magnetic spectra at azimuthal angles of 0° and 180°, only small asymmetry was found, in accordance with previous work. When, however, the comparisons were made of the areas where electrons due to single elastic scattering preponderated, large asymmetry, in agreement with Mott's theoretical result, was found. The magnetic spectra in these double-scattering experiments are similar to those of P. B. Wagner (*Phys. Rev.*, **35**; 1930) in single 90°-scattering by gold of thickness 0·2 micron as well as by thick targets, most of the scattered electrons coming from very near the surface.

Spectrographic Observations of the 1940 Solar Eclipse

IN the December issue of the *Observatory* (**63**, 307; 1940) R. O. Redman reports on the total solar eclipse of October 1, 1940, as observed spectroscopically by the expedition to Calvinia, South Africa. In collaboration with Dr. H. Zanstra, Dr. Redman used a large slit spectrograph for studying the transition between the absorption spectrum of the sun's disk and the emission spectrum of the chromosphere. The instrument consisted of three 3-inch prisms, with collimator and camera lenses of 8 ft. focal length giving a flat field between 4030 A. and 5000 A., and a dispersion of $H\gamma$ of 3·5 A./mm. It was sunk in a pit 10 ft. deep so that the slit was at ground-level; by this means a diurnal temperature range of 30° F. at the surface was reduced to less than 1° F. close to the prisms. Discontinuous movement of the plate by means of a hand crank uniformly turned enabled ten half-second exposures separated by intervals of 1 sec. to be made both at second and at third contact. During the eclipse, the sky was cloudless and transparent, but definition was poor. Totality came 3 seconds earlier than the computed time, so that neither series of exposures was perfectly centred on the actual time of contact, but the plates are otherwise satisfactory and should yield much valuable information regarding the physical conditions in the solar atmosphere. The work of measuring the spectrograms will, of course, take many months, and the results will be awaited with interest.

SELECTIVE ABSORPTION OF LIGHT IN INTERSTELLAR SPACE

BY DR. A. HUNTER,
ROYAL OBSERVATORY, GREENWICH

THERE is perhaps no subject which has attracted more attention from astronomers during the past decade than that of interstellar absorption. It is of the utmost importance to those who study the structure of the universe to know whether a distant star looks faint because it is faint, or because the light it emits is partly lost on its way to us. The standard way of estimating the distance of a star which is beyond trigonometrical reach is by photometric means: the star's apparent brightness m is compared with its absolute brightness M, and its distance r derived from the relation

$$\log r = 0{\cdot}2\,(m - M) + 1, \qquad (1)$$

which is simply a disguised form of the inverse-square law. The absolute magnitude M is usually estimated by spectroscopic means: sometimes a value can be assigned to all stars of a given spectral sub-type; otherwise a division is made inside each spectral sub-type into stars of high and low luminosity by using delicate spectral criteria which are functions of surface gravity and thence of M. The luminosities so obtained are adjusted to agree with those derived from trigonometric parallaxes, and are therefore unlikely to be much in error except perhaps for the more distant stars. Since the values of m are directly observed and are never in doubt, it would seem that evaluation of (1) should provide an unexceptionable distance for any star within reach of spectroscopic observation. But if the inverse-square law does not hold, if the light falls off more rapidly than (1) suggests because of interstellar absorption, the whole question of cosmic distances goes back into the melting-pot. The evidence[1,2] for the presence of interstellar matter capable of absorbing or scattering light is now so overwhelming that the possibility that the scale of distance implied by (1) is seriously wrong can no longer be neglected.

The direction in which absorption affects estimated distances can be seen at once. Dimming of starlight due to unsuspected absorption will be falsely attributed to inverse-square dimming; the stars will therefore have been put farther away than they really are; and the dimensions of the universe will have been correspondingly over-estimated. Quantitative estimation of the magnitude of the effect is much more difficult. Within recent years an attempt has been made to use the selective nature of the absorption as a guide here. So long as the particles in interstellar space are not all so large as to produce mere non-selective blocking, the absorption will be expected to increase as the wave-length of the light decreases. This is in fact found to be true. The atoms and atomic ions now known[1] to be present between the stars in great quantities would be expected to produce the Rayleigh λ^{-4} type of scattering. In fact, however, dilution by larger particles must occur, since spectrophotometric comparisons[3] of distant reddened stars with nearby unreddened ones of the same spectral type show that the absorption is more nearly proportional to λ^{-1}, or perhaps[4] to a power series in λ^{-1} in which the first term predominates. Let us adopt the λ^{-1} law as a first approximation, so that at wave-length λ in the spectrum of a star the absorption A_λ in magnitudes is expressed by

$$A_\lambda = A_1/\lambda, \qquad (2)$$

where A_1 is a constant for the star concerned. Measurements of space reddening, whether in terms of colour index[3] or of spectrophotometric gradient[4], show the difference of absorption at two regions in the spectrum. Let the true magnitudes of the star at effective wave-lengths λ_r and λ_b in the red and blue respectively be m_r, m_b. Then the corresponding magnitudes in the presence of absorption obeying (2) will be $m_r + A_1/\lambda_r$, $m_b + A_1/\lambda_b$. The true colour index of the star

$$C = m_b - m_r$$

will be modified by the absorption to

$$C' = m_b + A_1/\lambda_b - (m_r + A_1/\lambda_r),$$

the difference being defined as the colour excess

$$E = A_1\,(1/\lambda_b - 1/\lambda_r).$$

For colour indices measured at, say, 5500 A. and 4400 A.,

$$E = 4{\cdot}55 \times 10^{-5}\,A_1 \qquad (3)$$

Combining (2) and (3), we have for the total absorption at 4400 A.

$$A_{4400} = 5{\cdot}0\,E,$$

and for visual magnitudes

$$A_{5500} = 4{\cdot}0\,E.$$

In the presence of absorption, then, the relation (1) becomes

$$\left.\begin{aligned} \log r &= 0{\cdot}2\,(m - 5E - M) + 1 \\ \text{or } \log r &= 0{\cdot}2\,(m - 4E - M) + 1, \end{aligned}\right\} \qquad (4)$$

according as m and M are measured in photographic or visual light respectively. Similar equations with different numerical coefficients of E will hold for the various ways of measuring E, m, and M. The distances given by all such equations are, however, still only upper limits to the true distances, since there may be in the line of sight non-selective absorption not obeying (2). However, they are at least an improvement on the crude values given by (1).

A vexed question now arises in measuring E for substitution in (4). As above defined, E is the difference between the true colour index of a star and the observed colour index, which is modified by absorption. The true colour of a distant star cannot, of course, be observed, and it is usual to take it as identical with the colour observed for a nearby star of the same spectral sub-type, since over short distances absorption will not affect the colour index appreciably. The tacit assumption here is that all stars of a given sub-type have the same intrinsic colour. The roots of this assumption reach further than one might at first sight suspect. Suppose, for example, the colour

of a star of a given sub-type is a function of its luminosity. Then since in any practical observational programme the range of apparent brightness in the stars observed is necessarily small, so that luminosity correlates partially with distance (see (1)), the colour will seem to be a function of distance. But this is just what would be expected if space absorption in the line of sight causes reddening. Is, then, some at least of the observed colour excess to be attributed to a luminosity effect? Evidence on this point has hitherto been conflicting, but by investigation of the colours of stars in galactic clusters, where no question of differential space reddening arises, it has been established[6] that for early-type stars the dependence of colour on luminosity is very small. Luckily these stars are just the ones which can be seen at great distances; they are therefore invaluable for investigating space absorption.

Advantage has been taken of this fact in two recent publications[3,5] dealing with the colours of *B*-type stars. The main conclusions of both papers agree, though the treatment of the data differs somewhat. The distribution of the scattering particles is far from uniform; for example, it does not resemble that of the interstellar calcium ions, which are so well scattered that the strength of the 'detached' lines they produce in the spectra of distant stars is perhaps the best available measure of large stellar distances. Most of the heavily reddened stars are in low galactic latitudes, so that the material must be confined fairly closely to the plane of the galaxy. The absorption in the plane itself varies considerably with galactic longitude, and even at one particular longitude seems to be only roughly proportional to distance. This large dispersion in the correlation between colour excess and distance for a given direction in space leads Stebbins and his collaborators[7] to suggest that a mean coefficient of selective absorption can have little significance—a conclusion which throws doubt on the validity of many recent investigations based on such a mean. Hunter and Martin[5], however, trace much of the dispersion to uncertainty in the stellar distances. When this is allowed for, more than 90 per cent of their stars fit a linear correlation satisfactorily, and the abnormal colorations of many of the remainder can be accounted for by the presence of absorbing clouds for which independent evidence exists.

Whichever view is ultimately found to be correct, it is evident that the problem of space absorption is much more complicated than had been supposed even a decade ago. However, the main conclusions are now emerging: confined to within a few hundred parsecs of the plane of the galaxy, and extending in that plane to at least two or three thousand parsecs from the sun, there is an irregular stratum of dust particles which dims and reddens the light from stars embedded in it. In addition to this stratum, there are the galactic nebulæ and dark obscuring clouds which outline the zone of avoidance of the extragalactic nebulæ. The effects of these two sources of absorption combine to reduce by a factor of two or more[8] the diameter previously assigned to our stellar system. The size of the dominant particle in the reddening stratum is about the wave-length of visible light; in some at least of the dark nebulæ there are larger particles producing non-selective absorption. The distribution of the absorbing material is so irregular that many observational results are at present in apparent contradiction; and before the generalizations noted above can be added to with certainty, much more observational work must be carried out.

[1] Dunham, T., *Proc. Amer. Phil. Soc.*, **81**, 277 (1939).
[2] Seares, F. H., *Publ. Astr. Soc. Pacif.*, **52**, 80 (1940).
[3] Stebbins, J., Huffer, C. M., and Whitford, A. E., *Astrophys. J.*, **90**, 209 (1939).
[4] Barbier, D., and Chalonge, D., *C. R.*, **210**, 166 (1940).
[5] Hunter, A., and Martin, E. G., *Mon. Not. Roy. Astr. Soc.*, **100**, 669 (1940).
[6] Hunter, A., and Martin, E. G., *Mon. Not. Roy. Astr. Soc.*, **100**, 656 (1940).
[7] Stebbins, J., Huffer, C. M., and Whitford, A. E., *Astrophys. J.*, **92**, 193 (1940).

DAM CONSTRUCTION IN THE TENNESSEE VALLEY

TRANSPORT, irrigation and electric power engineers all over the world are greatly interested in the Mississippi River system in the south-eastern part of the United States; and especially in the large-scale works which have been undertaken in the lower reaches with the view of alleviating the effects of the devastating floods which have frequently occurred. Mention has also been made of the controversy on the subject of the possible effects, on the lower river floods, of the construction of storage reservoirs in the upper reaches of important tributary streams.

In the issue of *Engineering* of January 3, there is published a map of the Tennessee Valley Authority's area showing the sites of the various dams which have been built, or are being built, on the river and its tributaries. In this connexion, it is of interest to note that, in House Document No. 1 of the 74th United States Congress, the president of the Mississippi River Commission is quoted as stating that "This Commission has recently submitted a separate report on a comprehensive system of tributary reservoirs for control of floods in the lower Mississippi River. In this report it was shown that, in connexion with the existing levee system, substantially complete protection, except for backwater areas, might be obtained by such a tributary reservoir system."

Among the tributaries of the Mississippi the Tennessee River occupies an important place. Rising in the Clinch Mountains and flowing through Tennessee and Northern Alabama, it joins the Ohio River at Paducah, in Kentucky, some fifty miles above Cairo, where the Ohio flows into the Mississippi. The Tennessee Valley Authority controls the whole of the Tennessee River. Flood control was only one of the objectives of the Tennessee Valley Act of 1933, which created this Authority. It is also engaged, as is well known, in electric power production on a large scale and in the manufacture of nitrates at Muscle Shoals.

Potentially, the Tennessee River is an important waterway for navigation, and the control which is given by construction of dams is also of benefit in connexion with navigation of the Ohio and Mississippi

Rivers. By the working out of what is considered to be the best economic compromise, the works that are being carried out on the Tennessee River serve the three purposes of aiding navigation, flood control and the generation of electricity. An incidental result of the construction of large reservoirs has been the development of the Great Smoky Mountains National Park, one of the great recreational areas of the United States.

The construction of the Norris Dam was definitely authorized in the original legislation creating the Tennessee Valley Authority. It is situated on the Clinch River, about twenty miles north-west of Knoxville in Tennessee. The drainage area above the dam, which includes that of the Powell River, represents 7·26 per cent of the total area of 40,600 sq. miles of the Tennessee River basin. Work was begun on the dam in October 1933, and it was completed in June 1936.

The dam structure consists of a straight gravity-type mass-concrete section 1,560 ft. long, anchored to the solid rock on the west side of the gorge in which it is situated. At the east end it is connected to the hill-side by a 300 ft. length of rolled embankment with a concrete core wall, which is built into the concrete of the dam. A power house is situated at the base of the down-stream face of the dam. Alongside this is a spillway the section of which is 332 ft. wide. The thickness of the dam at its base is 204 ft. and its height, from the lowest point of the power house foundation to the level of the roadway along the top, is 265 ft. This roadway forms part of the highway system of the area. The spillway discharge is controlled by three hydraulically operated steel sector crest gates, each 100 ft. long by 14 ft. high. The gate openings are spanned by a concrete-encased steel girder roadway bridge.

The normal impounded level of the reservoir above the dam is to elevation +1020, the crest of the spillway. This is also the level to which the water is allowed to rise for power storage, and gives a gross head of 194 ft. The volume of the reservoir above the dam between elevation +1020 and elevation +962, 58 ft. below, is 1,500,000 acre-ft., this being the amount of water available for regulation of the power output and for navigation. This storage allows for an average contribution of 5,000 cusecs to the low-water flow of the Clinch and Tennessee Rivers, and an increase in the flow of the latter at Wilson Dam of 10,000–16,000 cusecs for 97 per cent of the year. With the regulation afforded by the Norris Dam, the extreme low-water flow at the Wilson Dam, below, is about 12,000 cusecs. By closing the spillway gates of the Norris Dam, water may be stored in the zone between elevation +962 and elevation +1047. This gives a stored volume of 2,500,000 acre-ft. When water is being impounded between these elevations, the outflow is maintained as nearly uniform as possible, and is not permitted to exceed 30,000 cusecs. This is equivalent to about bank-full conditions in the Clinch River.

The power house, which is approximately 70 ft. wide by 204 ft. long, contains two 56,000 kva. generating sets, supplied by the Westinghouse Electric and Manufacturing Company. They are rated at 50,000 kva. at 90 per cent power factor. By means of special electric relays, the exciter circuits can be opened and the generator brakes applied. The brakes can stop the machines in 15 minutes. The headings are practically air-tight, so that in emergency carbon dioxide fire-extinguishing equipment may be used.

FORTHCOMING EVENTS

[Meeting marked with an asterisk is open to the public.]

Monday, February 3

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir David Chadwick: "Some Problems of World Economic Development" (Cantor Lectures, 3).

SOCIETY OF CHEMICAL INDUSTRY (at the Chemical Society's Rooms, Burlington House, Piccadilly, London, W.1), at 2 p.m.—Dr. E. F. Armstrong, F.R.S.: The first H. E. Armstrong Lecture.

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 3 p.m.—Prof. F. Ronald Edwards: "Dried Plasma: its Preparation and Administration for the Syndrome of Shock".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Mr. Alan Browne: "Alpine New Zealand".

Tuesday, February 4

CHADWICK TRUST (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Sir Walter Langdon-Brown: "Mental Health in War-Time".*

WARBURG INSTITUTE (at the Imperial Institute Buildings, South Kensington, London, S.W.7), at 2.30 p.m.—Dr. F. Saxl: "Mithras—The History of an Indo-European Divinity".

Thursday, February 6

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Discussion on "Diffuse Reflections of X-rays by Crystals". To be opened by Sir William Bragg, O.M., F.R.S. Probable speakers: Prof. J. D. Bernal, F.R.S., Prof. Max Born, F.R.S., Sir Lawrence Bragg, F.R.S., Dr. C. G. Darwin, F.R.S., Dr. H. A. Jahn, Dr. K. Lonsdale, Dr. G. D. Preston.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT TO THE ADVISORY OFFICER IN ANIMAL HUSBANDRY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (February 10).

GRADUATE ASSISTANT TEACHER FOR MECHANICAL ENGINEERING SUBJECTS—The Principal, Acton Technical College, High Street, Acton, London, W.3 (February 10).

DEMONSTRATOR IN ANATOMY—The Registrar, University, Sheffield (March 1).

EXAMINER (PHYSICIST) in the A.I.D. Test House, Harefield (non-metallic Materials section)—The Secretary, Ministry of Aircraft Production, A.I.D.—I.C.S.1(T), Leatherhead, Surrey.

TECHNICAL ASSISTANT (male) in the Department of Economics—The Secretary, South Eastern Agricultural College, Wye, Ashford, Kent.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

New Beginnings: a Scheme of Study for the Year 1941 for Adult Schools. Pp. viii+225. (London: National Adult School Union.) 1*s.* 6*d.* net. [2312

A Study of the Diet and Social Conditions of the Working-class Families in Newcastle-upon-Tyne. By Najib U. Khan. Pp. 40. (Newcastle-upon-Tyne: The Dispensary.) 1*s.* [2412

Other Countries

Report of the King Institute of Preventive Medicine, Guindy, for the Year ending 30th September 1939, by Lt.-Col. H. E. Shortt; and Report of the Government Analyst, Madras, by Herbert Hawley. Pp. 83+6. (Madras: Government Press.) 8 annas. [2412

Survey of India. Geodetic Report, 1939. Pp. v+66+13 plates. 3 rupees; 5*s.* Professional Paper No. 30: Gravity Anomalies and the Figure of the Earth. By B. L. Gulatee. Pp. viii+116. 3 rupees; 5*s.* (Dehra Dun: Survey of India.) [2412